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CHONDROECTODERMAL DYSPLASIA (ELLIS-VAN CREVELD DISEASE)*

REPORT OF THREE CASES

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THE syndrome of chondroectodermal dysplasia was first recognized and named by Ellis and van Creveld[2] in 1940 when they described 3 patients who presented dysplasia of the cutaneous appendages—hair, nails and teeth; polydactylism in the hands; and dwarfism due to shortening of the legs. In 2 of their 3 patients, the hearts were enlarged and deformed. McIntosh had previously recorded all of the constituents of this syndrome, except cardiac malformation, in a girl four and one-half years of age during 1933,[3] and his findings were included in the report of Ellis and van Creveld as their third case. All of the other members of the families of these patients were normal and there was no evidence of genetic transmission of these bizarre multiple congenital dysplasias. No new cases have been described since the report of Ellis and van Creveld. My purpose, herein, is to record findings in 2 additional patients, three and thirteen months of age, and to present the later findings in a third patient when she was nineteen years of age, who had been described earlier, in the reports of McIntosh and of Ellis and van Creveld, when she was four and one-half years of age.

Notwithstanding the paucity of reports on the Ellis-van Creveld syndrome, other types of congenital cutaneoskeletal syndromes, especially the hereditary familial forms, have been recorded in substantial numbers. During the fifty years prior to 1948, more than 100 examples of combined hereditary dysplasias of the nails and bones had been described, according to Mino, Mino and Livingstone.[5] In many of these individuals, the anomalies were curiously limited to fingernails and patellas.[6] In several others, the radial heads were hypoplastic and in some instances dislocated with limitation of motion at the elbows. Several members of the same family in two or more generations have usually been affected. Turner[8] studied two families in which 35 of 79 persons showed dysplasias

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of the nails in combination with multiple anomalies of long bones; hair and teeth were normal in all members of both families. Wildervanck[9] found congenital hypoplasia of the radial heads and the patellas combined with dysplastic nails in five generations of one family; 22 of the 53 members of this family exhibited cutaneo-skeletal dysplasia. Hypoplastic fingernails and bilateral iliac exostoses have been found in 1 patient.[7]

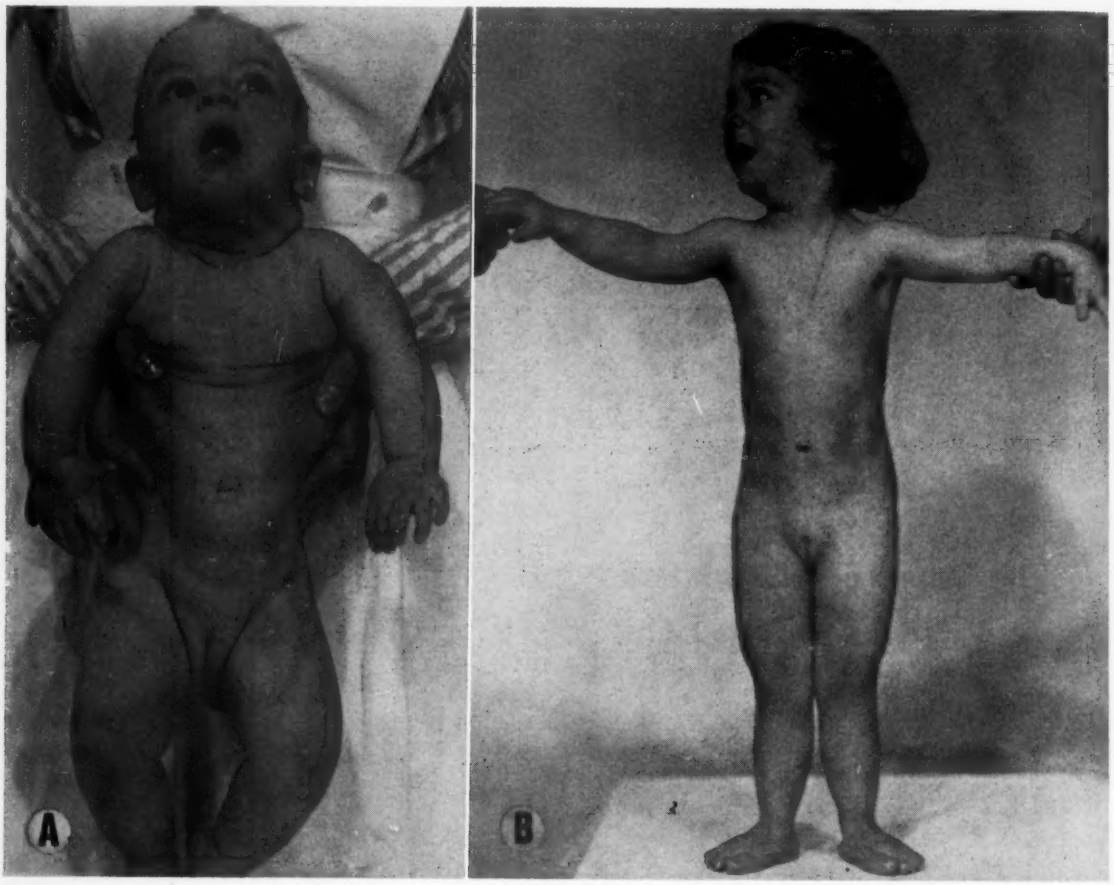

FIG. 1. Case 1. Photographs at three and one-half months of age (*A*) and twenty-eight months (*B*) which show short thick extremities and normal trunk and head. Dwarfism is due to shortening of the legs, in which the relative shortening in the shanks is greater than the shortening of the thighs. Hair in the scalp, eyebrows and eyelashes is normal in quantity and quality.

CASE REPORTS ON CHONDROECTODERMAL DYSPLASIA

CASE 1. S.F. was the daughter of healthy parents, thirty and twenty-six years of age. A sister, six years of age, was normal. Congenital malformations and dwarfism had never occurred before in either family. At birth there were six fingers in each hand and six toes in each foot. At three and one-half months of age (Fig. 1) she was 53 cm. in length; circumference of head was 37 cm.; abdomen 37 cm.; and thorax 37 cm. Mental and motor development were normal. There were no abnormal cardiac signs. The normal sulcus between the upper lip and gum was obliterated by fusion of these structures. Deformities of hands and feet and hypoplasia of nails are shown in Figure 2.

The malformations and disproportions did not change significantly with advancing age. At three and one-half years, she was well nourished and had normal mental and motor powers. Dentition was retarded; the erupted teeth were all small, widely spaced and deformed. Eight teeth were visible in the upper

gum and seven in the lower gum. Roentgenograms disclosed delayed maturation and calcification of all deciduous teeth, which represented a dental age of about six months. The only permanent tooth buds visible were those of the upper and lower first molars on the right side and the lower first molars on the left side. Clinical, roentgenographic and electrocardiographic examinations all yielded normal findings for the heart. Blood and urine were normal in several examinations. Serum contained normal amounts of calcium and phosphorus and its phosphatase activity was normal.

Case II. R.M., thirteen months of age, was the daughter of healthy parents and she had two normal siblings. Congenital malformations had not been recognized in any other members of the family. Gestation and birth were normal but, at birth, extra fingers and congenital heart disease were detected. She was never well. She gained weight and length slowly and vomited often. She suffered from frequent respiratory infections, during which she became cyanotic and coughed incessantly. After the tenth week,

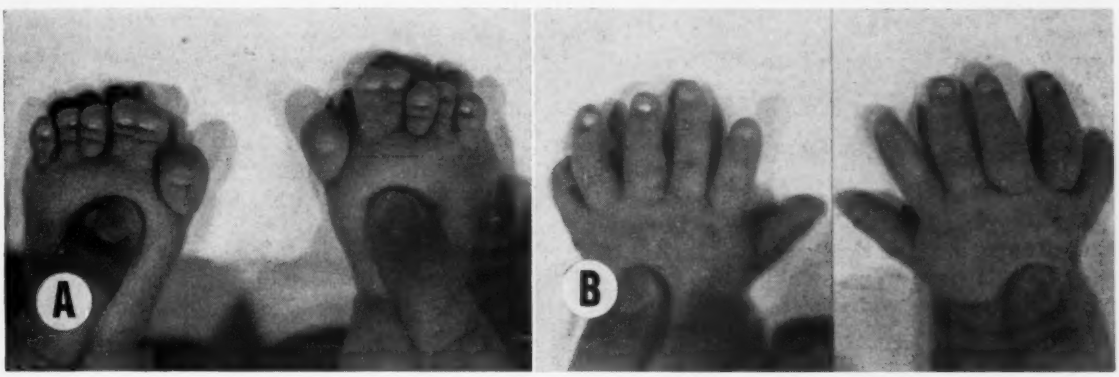

Fig. 2. Case I. Photographs of feet (*A*) and hands (*B*) at three and one-half months. There are six digits in each foot and each hand. The soft tissues of the second and third toes are fused. All of the nails are small and deformed.

Roentgen Findings in the Skeleton. Hands (Fig. 3) showed multiple deformities which included supernumerary phalanges and metacarpals, fusion of capitate and hamate bones, delayed maturation of primary phalangeal ossification centers and accelerated maturation of secondary phalangeal epiphyseal ossification centers. Similar changes in the feet are shown in Figure 4. All the bones in the arms were short at three and one-half months and the proximal ends of the ulnas were enlarged. At twenty-eight months, the findings were similar. Measurements at this time showed the humeral shafts to be 115 mm. in length, or 82 per cent of normal, according to the standards of Maresh;[4] radiuses and ulnas could not be measured owing to incomplete visualization. In the legs, all of the bones were short and thick (Fig. 5). At twenty-eight months femurs were 155 mm. in length, or 84 per cent of normal; tibias 115 mm., or 78 per cent of normal; and fibulas 96 mm., or 66 per cent of normal. Relatively, shortening was greatest in the fibulas and least in the femurs. The heart and lungs and bones of the thorax were normal.

weight remained almost stationary and motor development practically ceased. At fourteen months, she could not stand alone, tired very easily and slept most of the time.

At thirteen months, she weighed 12½ pounds (5.3 kilograms); was 64 cm. in length, circumference of head was 42 cm.; chest 38 cm.; and abdomen 35 cm. There was no diffuse cyanosis but the skin was mottled in a bluish pattern. She was not edematous and fingers were not clubbed She was constantly dyspneic and hyperirritable. Hair was scanty in the scalp but normally abundant in the eyebrows and eyelashes; skin was normally moist. The outlines of unerupted teeth beneath the oral mucous membrane were irregular and deformed and the upper lip was fused with the upper gum (Fig. 6). In the precordial region, the thoracic wall bulged ventrad; the heart was greatly enlarged to palpation and percussion. A coarse thrill was palpable over the precordium where a loud systolic murmur was heard which was well transmitted to the left axilla and back. Abdomen was scaphoid and the extremities short. Each hand

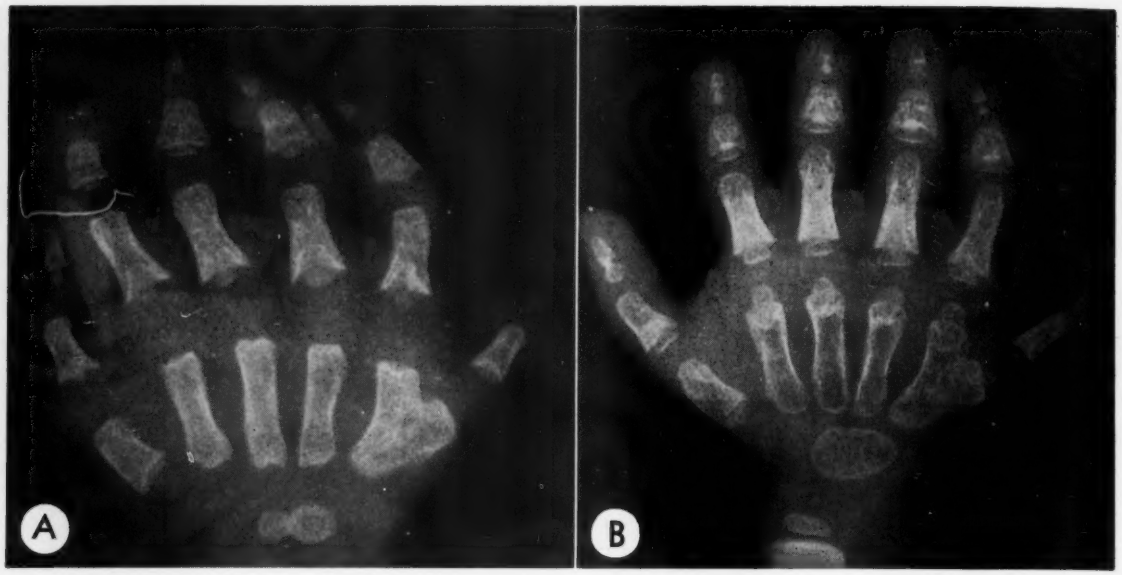

Fig. 3. Case 1. Roentgenograms of hands. (*A*) At three and one-half months, the two ossification centers of the hamate and capitate bones are partially fused. Fifth and sixth metacarpals are fused side to side and the radial side of the fifth is deeply concave. All of the metacarpals are short but there are no secondary ossification centers in their epiphyseal cartilages. Six proximal phalanges are all short and thick with cupped bases, opposite which there are relatively large ossification centers in the proximal epiphyseal cartilages. Similar but more pronounced changes are present in the middle phalanges. Maturation of the proximal and middle phalanges is accelerated and approximates the average for a girl eighteen months of age. In the distal phalanges, in contrast, there are no secondary centers, and the primary centers are underdeveloped and simulate fetal maturation. In the rudimentary sixth finger, there is no center for the distal phalanx; in the first finger, the distal phalanx approximates the maturation of the middle phalanges of the other digits. (*B*) At twenty-eight months, secondary epiphyseal centers of the proximal and middle phalanges are beginning to fuse with their shafts. In the distal phalanges, relatively enormous secondary centers, already partially fused with their shafts, are now evident. Maturation of the phalanges is accelerated and approximates the average for a girl twelve to fourteen years. Capitate and hamate bones are now completely fused into a single oval mass.

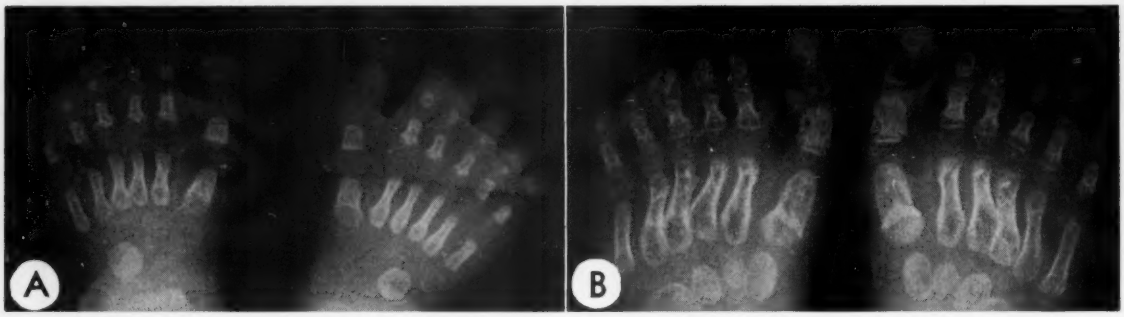

Fig. 4. Case 1. Roentgenograms of the feet. (*A*) At three and one-half months there are six independent metatarsals which have no secondary centers. All of the primary ossification centers for the shafts of the phalanges are underdeveloped; there are no primary centers for the distal phalanges. Notwithstanding this delayed maturation of primary centers, secondary centers have already appeared in the proximal epiphyseal cartilages of the proximal phalanges; normally these secondary centers do not appear until after the twelfth month. (*B*) At twenty-eight months, the secondary centers of the proximal phalanges are now almost completely fused with their shafts, although the primary centers for the middle phalanges are still rudimentary and the primary centers for the distal phalanges have not appeared. The maturation of the proximal phalanges is accelerated to about fifteen years and that of the middle and distal phalanges is retarded to prenatal levels. Tarsal and metatarsal maturation is approximately normal.

Fig. 5. Case 1. Roentgenograms of knees. (*A*) At three and one-half months, the proximal end of the tibial shaft is widened and pointed; its epiphyseal ossification center is small ectopic, lying mediad opposite the shorter slope of the peaked tibial shaft. The disproportionate shortening of the fibula is well shown in this film. (*B*) At twenty-eight months, the peaked deformity of the tibial shaft and medial displacement of the tibial epiphyseal ossification center persist. An enlargement of the lateral half of the femoral epiphyseal ossification center is now visible; this enlargement is probably compensatory to the hypoplasia of the lateral portion of the tibial epiphyseal ossification center and the lateral portion of the end of the tibial shaft. The patella is normally mineralized.

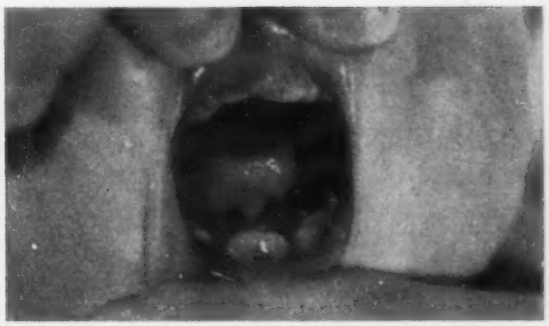

Fig. 6. Case 11. Fusion of the upper lip with its gum at fourteen months.

Fig. 7. Case 11. (*A*) Hands at fourteen months. All maturation is greatly delayed, owing to longstanding severe cardiac failure. Otherwise, the deformities are practically identical with those in the hands of Case 1. (*B*) Legs at fourteen months. The widening and pointing of the proximal ends of the tibial shafts are similar to the findings in Case 1, as is the medial ectopia of the epiphyseal ossification centers of the tibias.

had six fingers but each foot had five toes. Fingernails and toenails were small and deformed.

The blood and urine were normal chemically and microscopically; serum phosphatase activity was normal. Left axis deviation was found in electrocardiograms. All symptoms persisted until the seventeenth month when she was last seen; the severity of cardiac and respiratory signs indicated she could not survive for long.

Roentgen findings (Fig. 7) were similar to those in Case 1, with the additional factors of undergrowth and underdevelopment of the

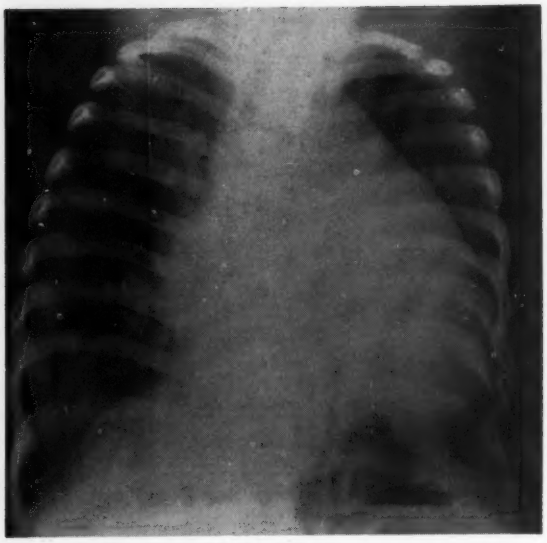

Fig. 8. Case II. Left-sided enlargement of the heart at fourteen months. The cardiothoracic index was 0.69.

skeleton due to longstanding cardiac and respiratory insufficiencies. All bones were short and thick; the proximal ends of the ulnas were enlarged. The humeral shafts measured 74 mm. in length, or 70 per cent of normal; radiuses 52 mm., or 56 per cent of normal; and ulnas 59 mm., or 65 per cent of normal. Tibial shafts were 64 mm. long, or 57 per cent of normal, and the fibulas 55 mm., or 55 per cent of normal. The femurs could not be measured in the films owing to incomplete visualization. The cardiac shadow was enlarged and deformed (Fig. 8). In the shadow of the mandible all of the deciduous teeth appeared to be too small and there were no dental follicles for permanent teeth.

Case III. The findings in this girl, B.P., when she was fifty-two months of age were first presented in 1933[3] and in 1940.[2]

She first came to the Babies Hospital in 1932 when she was fifty-two months of age for treatment of squint and for the removal of rudimentary sixth fingers on each hand. Father and mother were first cousins, twenty-nine and twenty-seven years of age; both were normal in stature and had no deformities. There were no siblings. At birth, small stature and extra fingers on the hands were observed. Internal squint of the left eye was first detected during the third month. At two years of age, she was 69 cm. long and her mental and motor behavior was normal.

At fifty-two months she was 84 cm. in length, crown to umbilicus axis was 41 cm. long; umbilicus to sole axis 43 cm.; and circumference of head 47 cm. Nutrition was good and she was active and intelligent. Arms and legs were too short for her trunk (Fig. 9). Skin moisture and hair were normal but teeth were deficient and deformed (Fig. 10). Fingernails and toenails were all small and deformed and there were six hypoplastic fingers on each hand (Fig. 11).

Laboratory tests all gave normal results.

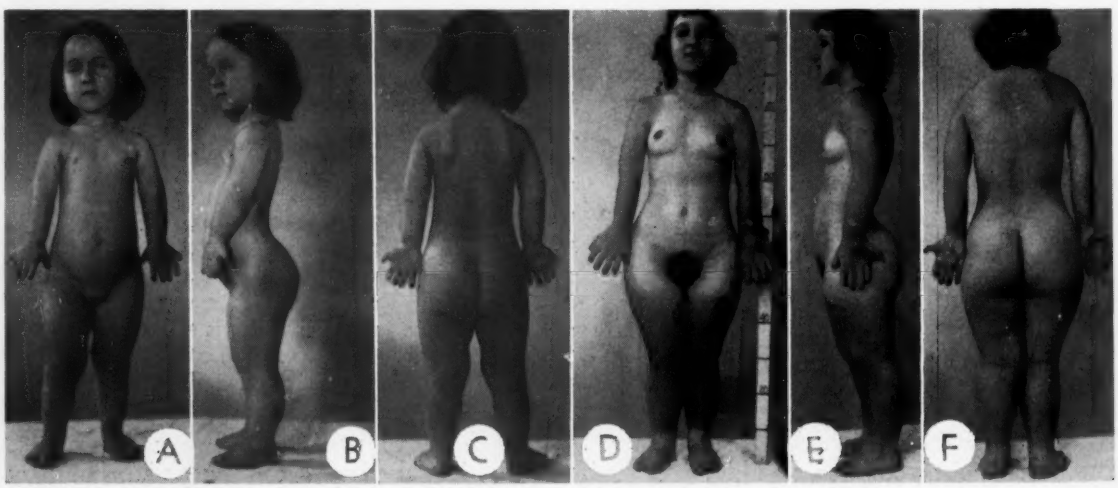

Fig. 9. Case III. (*A*) (*B*) (*C*) At fifty-two months. (*D*) (*E*) (*F*) At nineteen years. The extremities are all short due principally to disproportionate shortenings distal to the elbows and knees. Head and trunk are normal in length. The thorax is flat. Nutrition and general maturation were normal at all ages. Hair is normal. Scapulas are widely spaced and there is a moderate lumbar lordosis. The strabismus visible in (*A*) and (*B*) was corrected surgically.

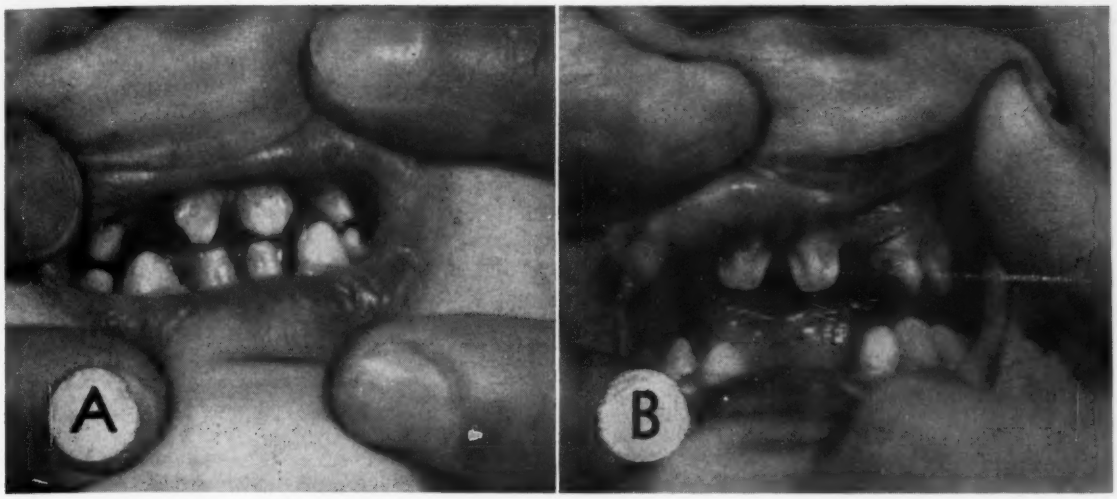

Fig. 10. Case III. Dental dysplasia at fifty-two months (*A*), and nineteen years (*B*). Some of the ventral teeth were cone shaped.

The blood and urine were normal chemically and cytologically. Wassermann and Kahn tests gave nonsyphilitic reactions in serum, which contained normal quantities of nonprotein nitrogen, chloride, dextrose, calcium, phosphorus, cholesterol and protein.

Immediate surgical correction of the squint and removal of extra fingers were refused by the father. After ten years, she weighed 23.4 kilograms and nutrition was excellent; she had been healthy save for deformities and dwarfism. She was 114 cm. in height. Menstrual flow began during the thirteenth year and became and remained regular. At nineteen years, strabismus was corrected and supernumerary fingers were excised; there was an immediate improvement in the mental and emotional state of the patient following these corrective procedures, which had been postponed far too long owing to the father's earlier refusal to permit them. Growth of the hair was still normally abundant and skin moisture was normal. Fingernails and toenails, however, remained small and fractured easily. Dental deficiencies were still pronounced, but apparently she concealed them without too much difficulty, and she chewed all types of food without hardship. Heart was normal in clinical, roentgen and electrocardiographic examinations. At the time of this writing she is an intelligent, cheerful, industrious girl of twenty-three years who has received a university degree. She is handicapped principally by the shortness of her stature and the deformities of her fingers which prevent her from learning most of the manual skills. Flexion at both elbows is slightly limited and her gait is slow owing to the smallness of her steps.

Roentgen changes in the hands (Fig. 12)

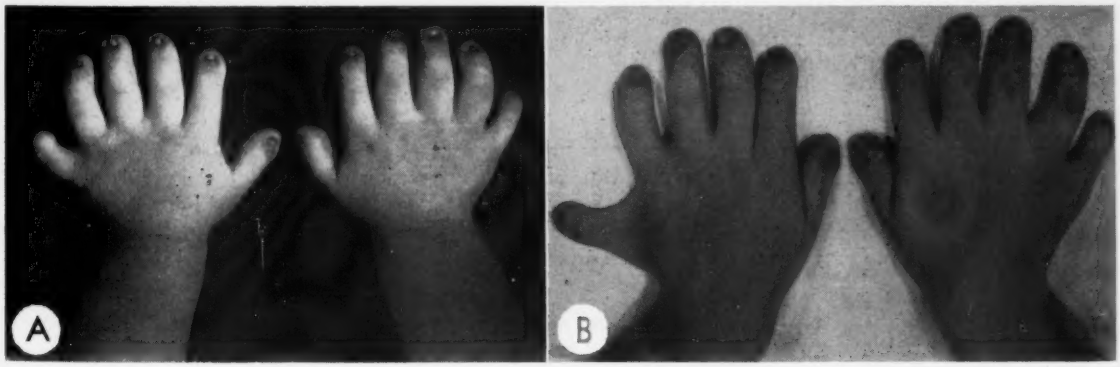

Fig. 11. Case III. Photographs of hands at fifty-two months (*A*), and nineteen years (*B*). All of the nails are small and set back on the finger tips. There are no nails on the rudimentary sixth fingers. The hands are short and wide with the most marked shortening in more distal segments of the fingers.

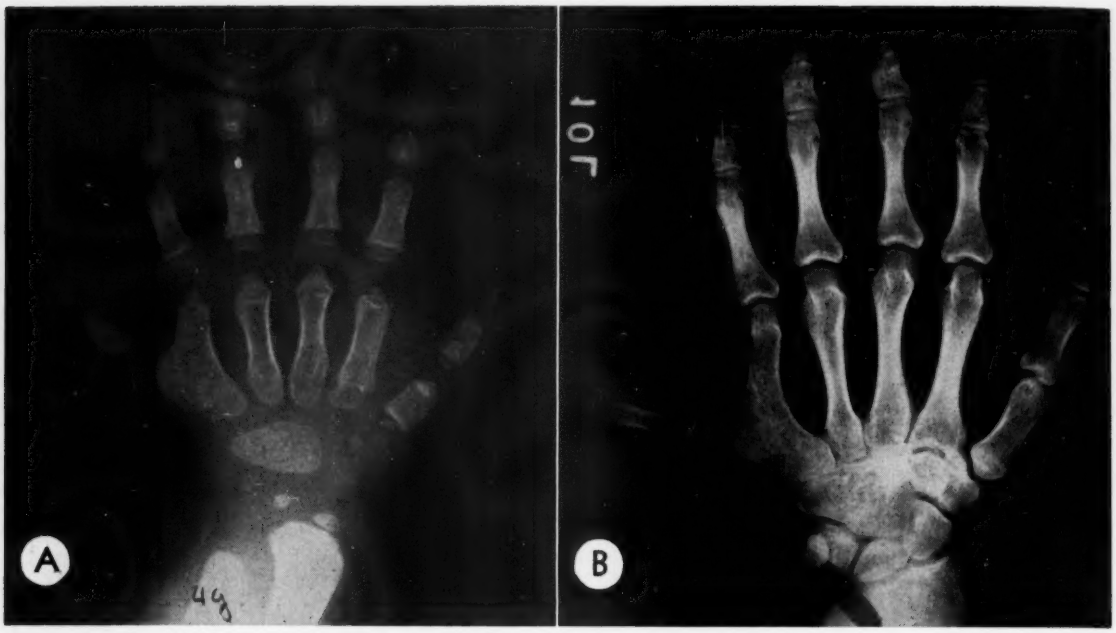

Fig. 12. Case III. Roentgenograms of the hands. (*A*) At fifty-two months, the findings are similar to those in the other 2 patients. Capitate and hamate bones are fused into a single mass. Fifth and sixth metacarpals are partially fused. All of the phalanges are shortened. Maturation of the middle phalanges is accelerated; primary and secondary ossification centers are already fused. Distal phalanges are extremely hypoplastic and represent a prenatal level of development. End of the radius is large and bent toward a small ulna. Epiphyseal ossification center of the radius is small and eccentric. (*B*) At nineteen years. Of the carpal bones, only the capitate and hamate are fused. Maturation is now complete and all of the earlier deformities persist. Relative enlargement of the end of the radius and its bending ulnaward are well shown. Ossification centers for the sesamoid bones have not appeared.

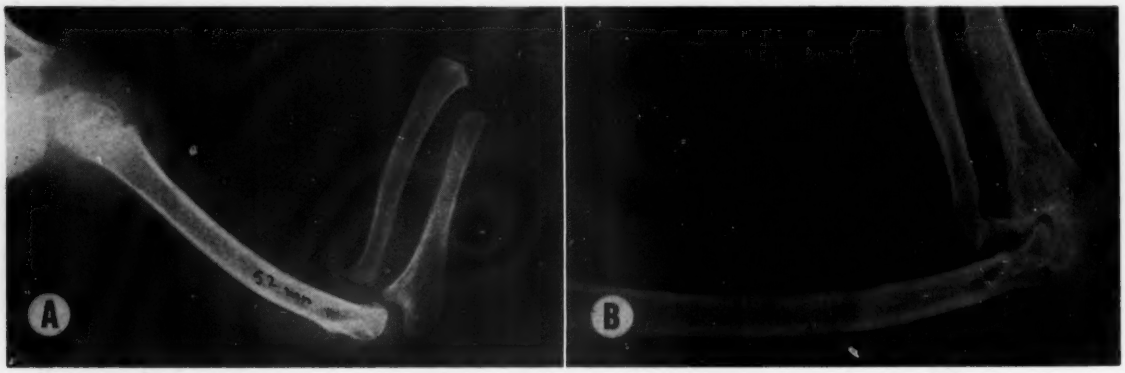

Fig. 13. Case III. Roentgenograms of right arm. (*A*) At fifty-two months all bones are short and heavy. Shortening is greatest in the ulna, which has caused a compensatory ventral dislocation of the radial head at the elbow. The proximal end of the ulna and distal end of the radius are enlarged; the proximal end of the radius and distal end of the ulna are too small. (*B*) At nineteen years, the proximal hypoplastic end of the radius is still displaced ventrad and appears to articulate high on the ventral surface of the humerus. Semilunar notch of the ulna is narrow and shallow; the olecranon process is hypoplastic.

included shortening of all of the tubular bones, which becomes more marked progressively from the metacarpals to the distal phalanges; polydactylism; polymetacarpalism; synmetacarpalism; syncarpalism; acceleration of maturation of secondary epiphyseal ossification centers of the phalanges; retardation of maturation of primary ossification centers of middle

Fig. 14. Case III. Roentgenograms of the legs. (*A*) At fifty-two months, tibia and fibula are both shortened with relatively greater shortening of the fibula. The proximal end of the tibial shaft is widened and its cephalic edge is pointed with a longer lateral slope and a shorter medial slope; the latter is capped by a small, thin, triangular ossification center in the epiphyseal cartilage. A small exostosis projects mediad and caudad from the medial cortical wall (arrow) of the tibia. In the distal tibial metaphysis, the spongiosa is irregularly sclerotic. (*B*) At nineteen years the primary, and epiphyseal ossification centers are now fused. The lateral impression (arrow) on the articular face of the tibia is deepened and enlarged. The intercondylar spines of the tibia are short and the intercondylar notch of the femur is shallow. Patella is large and well mineralized.

FIG. 15. Case III. Roentgenogram of pelvis at nineteen years. Sacrum is small; its tip is rotated upward and backward and its crest downward and forward. Necks of both femurs are bent upward and outward into extreme reversed coxa valga deformities. The femoral heads are flattened medially and their lateral segments project laterad well beyond the confines of the hypoplastic acetabular cavities.

and distal phalanges. In the feet, there were no extra digits or extra metacarpals but the tubular bones showed hypoplasia with retardation of primary centers and acceleration of secondary centers similar to those in the hands. Also the third metatarsals were disproportionately short and the medial cuneiforms relatively long. In each foot, at nineteen years, there was a huge os vesalanium. A single sesamoid was present in each foot near the distal end of the first metatarsal. At the same time, no sesamoids could be seen in the hands.

In the arms all of the bones were short and thick (Fig. 13). At fifty-two months the humeral shafts measured 115 mm. in length, or 70 per cent of normal; radiuses 79 mm., or 64 per cent of normal; ulnas 78 mm., or 57 per cent of normal. In the legs (Fig. 14) the femoral shafts were 164 mm. in length, or 70 per cent of normal; tibias 113 mm., or 59 per cent of normal; fibulas 107 mm., or 56 per cent of normal. The anomalies in the pelvis at nineteen years are shown in Figure 15.

Roentgen visualization of the mandible showed that the teeth were defective at fifty-two months when the superior and inferior deciduous lateral incisors were missing. There were no dental follicles for central and lateral incisors. Calcification of deciduous teeth was complete but resorption of roots had not begun. At nineteen years the teeth were still defective and deformed and irregularly spaced. Some of the ventral teeth were cone shaped. In the submandibular soft tissues there were several shadows of calcium density which were thought to represent calcifying tuberculosis of the submandibular lymph nodes; the cutaneous skin test for tuberculosis was positive at fifty-two months of age.

COMMENT

The cutaneous dysplasia in all 5 recorded cases have been severe and consistent. Teeth in both upper and lower jaws, in all cases, have been defective and deformed and retarded in their development. Every nail of every finger and toe of every patient has been too small, often deformed and often excessively friable. The nails on rudimentary sixth digits were usually absent. The hair, however, in all of our 3 patients was normal in quality and quantity; Ellis and van Creveld found alopecia in 2 patients. In every case, the skin was normally moistened and there was no constitutional evidence that any of these patients suffered from inadequate perspiration, as is the case in the anhidrotic type of congenital ectodermal dysplasia. The upper lip was fused with its gum pad in 4 of 5 patients; in the fifth, however, this lesion never developed.

Congenital cardiac disease was identified in 3 of the 5 known cases. All 3 patients had left-sided enlargement of the heart and harsh systolic murmurs. It is likely that patency of the interventricular septum is the dominant lesion in these congenitally malformed hearts. Heart disease may be an early cause of death, as seemed probable in Case II. On the other hand, there was not the slightest evidence of cardiorespiratory disease in our other 2 patients.

All of the tubular bones in the extremities of all patients were shortened and relatively thick. These bones were short absolutely and in proportion to the trunk. Ellis and van Creveld reported the trunk to be actually elongated in 1 of their patients.

Dwarfism is due almost exclusively to shortening of the legs. The pattern of the shortenings in the bones of the extremities, the progressively increased shortening from the trunk to the distal phalanges, has been found only in our patients and is a newly recognized and diagnostic feature of the Ellis-van Creveld disease. The root bones of the extremities, femurs and humeruses, are the least shortened and the middle and distal phalanges are the most shortened; in some cases, the primary ossification centers for the last-named failed to appear in the toes. The proportionate shortening of the different bones in our 3 patients was as follows: humeral shafts averaged 74 per cent of their normal lengths; radiuses 72 per cent; ulnas 68 per cent; femurs 80 per cent; tibias 74 per cent; and fibulas 59 per cent. In chondroectodermal dysplasia the root bones of the extremities are relatively the longest; in classical achondroplasia, the converse is true; the root bones are relatively the shortest.[1] In 5 patients with achondroplasia the average proportionate lengths in the long bones of the extremities, in comparison with the normal, were as follows: humeruses 55 per cent; radiuses 63 per cent; ulnas 66 per cent; femurs 54 per cent; tibias 60 per cent; fibulas 65 per cent. It is noteworthy that the fibulas, which are relatively the shortest bones in the legs of patients with chondroectodermal dysplasia, are relatively the longest bones in the legs of the achondroplastics. The progressive shortening of the bones distalward in chondroectodermal dysplasia is the exact converse of the findings in arachnodactylia, in which there is a progressive elongation of bones of the extremities distalward.

The deformities of the bones in chondroectodermal dysplasia, other than the shortenings, are also highly characteristic. The proximal ends of the ulnas and the distal ends of the radiuses were enlarged, while the distal ends of the ulnas and the proximal ends of the radiuses were too small. In Case III, the disproportionate shortening of the ulnas in relation to the radiuses caused compensatory dislocation of the radial heads from the elbows. The proximal widened ends of the tibial shafts were sharpened into low peaks with relatively long lateral slopes and short medial slopes, and the latter were capped by thin hypoplastic ossification centers in the proximal epiphyseal cartilages. Every tibia of every patient of all ages showed this deformity, which appears to be a pathognomonic lesion of the Ellis-van Creveld disease. The patellas were normal in all patients.

In all hands of all patients, the findings have been practically identical. Each hand had a rudimentary sixth digit attached to its ulnar side. Each of the hands had six metacarpals, and with the exception of one hand (the left hand in our Case III) the fifth and sixth metacarpals were fused side to side; the unfused sides of the fifth metacarpals were all deeply concave. In every carpus at all ages the capitate and hamate bones were fused.

In the feet, polydactylism and polymetatarsalism were exceptions; they occurred only in our Case I. There was no fusion of the metatarsals and none in the tarsals themselves.

Pelvic deformities were demonstrated satisfactorily only in our third patient after she became adult. The forward position of the sacral crest appeared to shorten critical pelvic diameters to a degree which might prove a cause of dystocia in the event of impregnation of a chondroectodermal dysplastic.

SUMMARY

1. Clinical and roentgen findings in three cases of chondroectodermal dysplasia (Ellis-van Creveld disease) are described in patients three months, thirteen months and nineteen years of age.

2. Constant lesions in all five recorded cases include: hypoplasia of teeth and nails; progressive shortenings distalward of the bones in the arms and in the legs; bilateral manual polydactylism and polymetacarpalism; synmetacarpalism; bi-

lateral fusion of capitate and hamate bones; retarded maturation of the primary ossification centers of the phalanges with accelerated maturation of their secondary ossification centers in the epiphyseal cartilages; characteristic deformities in the proximal ends of the tibias, proximal ends of the ulnas, and distal ends of the radiuses.

3. Inconstant lesions include: alopecia; fusion of upper lip and its gum; congenital malformation of the heart; dislocation of the heads of the radiuses; retarded maturation of the manual sesamoids; polydactylism and syndactylism in the feet; and polymetatarsalism.

4. Chondroectodermal dysplasia (Ellis-van Creveld disease) is a distinct congenital syndrome with several unique components which differentiate it decisively from all other congenital dysplasias and all other types of dwarfism.

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ADDENDUM

Keizer and Schilder have reported an incomplete example of the Ellis-van Creveld syndrome in a girl twenty-one years of age, since this manuscript was submitted for publication. (Keizer, D. P. R., and Schilder, J. H.: Ectodermal dysplasia, achondroplasia, and congenital morbus cordis. *Am. J. Dis. Child.*, 1951, *82*, 345.)

Vol. 68, No. 6

ROENTGEN APPEARANCE OF THE SMALL INTESTINE IN TUBERCULOUS PERITONITIS BEFORE AND AFTER STREPTOMYCIN THERAPY*

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SINCE peritonitis is a relatively uncommon manifestation of tuberculosis, the opportunity to study the pattern of the small intestine roentgenologically is not afforded frequently. Recent opportunity to study the small intestine roentgenologically in 3 cases of tuberculous peritonitis before, during, and after treatment with streptomycin, showed changes which form the basis for this report. Since the demonstration of the value of streptomycin in the treatment of tuberculous infections, several reports on the clinical courses of patients with tuberculous peritonitis so treated have appeared. We have been unable to find a report of roentgen studies of the small intestine of patients with tuberculous peritonitis treated with streptomycin.

Soper,[3] Ritvo,[2] and McCort[1] have described the pattern of the small intestine in tuberculous peritonitis. Wichelhausen and Brown,[4] in a review of 26 patients with tuberculous peritonitis, report that a gastrointestinal series was done in 16 with normal findings in 12 cases. One patient had a partial intestinal obstruction, one had a mild functional obstruction, not showing an intrinsic lesion but considerable segmentation of the ileum, one had obstruction of the small intestine and one had marked pylorospasm, incomplete filling of the duodenal cap and distortion of the duodenal bulb. The roentgenographic changes found have generally not been considered pathognomonic of tuberculous peritonitis since similar changes may be produced by other diseases. The abnormal patterns observed have been ascribed largely to peritoneal adhesions.

REPORT OF CASES

Case 1. O.S. (R-25709), a Negro, aged thirty, was admitted to the Veterans Administration Hospital, Fort Howard, Maryland, on January 2, 1948, with a six month history of periumbilical pain, worse after eating, but not associated with nausea or vomiting. The patient had lost 16 pounds in six weeks.

The abdomen was slightly distended but rigidity and tenderness were not present. The temperature became slightly elevated after admission. The abdomen became a little more distended with tenderness on deep palpation.

Blood studies showed a white blood cell count of 8,100, with 70 per cent lymphocytes. Bone marrow aspiration and biopsy from a lymph node were negative. The total serum proteins were 7.48 gm. per cent with an albumin-globulin ratio of 0.96 to 1.0. Five examinations of the concentrates of sputum collected over a period of twenty-four hours and gastric contents on two occasions were negative for acid fast bacilli.

The first gastrointestinal examination performed on January 6 demonstrated a normal small intestinal pattern and slight delay in motility. On January 19 a barium enema examination was normal.

Tuberculous peritonitis was suspected, and on March 4 an exploratory laparotomy was performed. The abdominal contents were ad-

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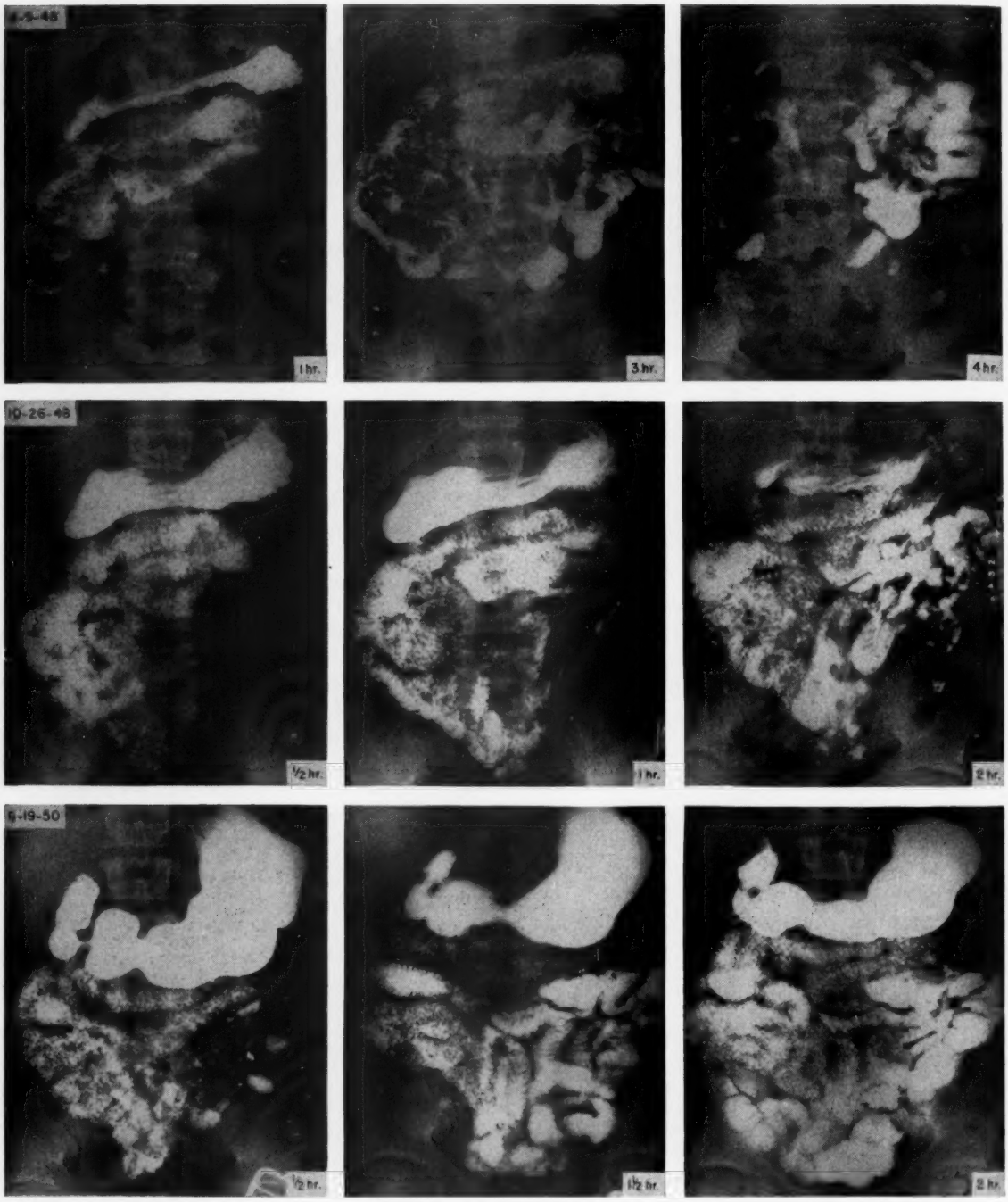

FIG. 1

4-9-48. Examination four days after start of streptomycin therapy showing abnormal small intestinal pattern. Adherent loops of intestine are displaced upward. "Puddling" is seen in left upper quadrant. Loss of regular outlines of mucosal folds, abnormal variation in lumen width, delayed motility and displacement of jejunum to right upper quadrant of the abdomen are present.

10-26-48. Examination four months after completion of streptomycin therapy showing improvement in the appearance of the small intestine.

6-19-50 Gastrointestinal series made two years after streptomycin therapy showing return of small intestinal pattern to within normal limits.

herent to the thick, vascular parietal peritoneum. The parietal and visceral peritoneum were studded with small whitish-yellow nodules which ranged from 0.1 cm. to 0.5 cm. in diameter. The intestinal wall inspected was not thickened. The specimen of omentum removed for biopsy showed caseous tuberculosis. Stained smears of peritoneal exudates were positive for acid fast bacilli.

One gram of streptomycin daily was administered on April 5 and given for forty-two days. The fever disappeared by lysis and became normal on April 9.

On April 9 (Fig. 1, 4-9-48) roentgenograms of the abdomen following ingestion of a barium meal, showed abnormal variation in the tone in the small intestine as evidenced by alternating narrowed and dilated segments. The mucosal folds were not seen in the dilated segments and this produced "puddling." Elsewhere the mucosal folds of the gut were irregular in height, width, and spacing. The small intestinal transit time was increased.

On September 17 roentgenograms following the ingestion of a barium meal showed delayed gastric emptying. The mucosal pattern and tone of the jejunum were normal. The mucosal folds of the ileum were virtually absent, producing a smooth outline. Delayed small intestinal motility was found. The general appearance of the small intestine showed considerable improvement as compared with the previous examination of April 9. A gastrointestinal series of October 26 (Fig. 1, 10-26-48) demonstrated a normal appearing stomach and duodenum. The tone and mucosal pattern of the jejunum were normal. The ileum showed minimal segmentation of the barium column and low mucosal folds. The small intestinal transit time was within normal limits. A final roentgen examination of the gastrointestinal tract on June 19, 1950 (Fig. 1, 6-19-50), demonstrated a normal appearing stomach and duodenum. The jejunum showed minimal hypertonicity. A transient segmentation of the barium column was observed in the upper ileum but the roentgen appearance of the small intestine was otherwise within normal limits.

Follow-up physical examination and chest roentgenogram of March 2, 1951, demonstrated the patient to be in an excellent state of health.

Case II. H.T. (R-21828), a Negro aged thirty-five, was admitted to the Veterans Administration Hospital, Fort Howard, Maryland, on June 3, 1948, because of acutely painful external hemorrhoids of three days' duration. He had been ill since February, 1948, with intermittent fever, vague pains in the extremities, increasing dyspnea on exertion and abdominal swelling. The patient had lost 15 pounds in weight. Pain in the left chest had been present for ten days. His mother had died at the age of twenty-two with pulmonary tuberculosis.

He was undernourished with a temperature of 101° F. Enlargement of the lymph nodes in the right axilla and both inguinal regions was present. A large left pleural effusion was present. The abdominal wall was tense from intraperitoneal fluid.

Total serum proteins were 6.85 grams per 100 cc., with an albumin-globulin ratio of 0.61 to 1.0. Numerous specimens of sputum, feces, gastric content and pleural fluid were negative for tubercle bacilli by smear, culture, and guinea pig inoculation.

The roentgenograms of the chest showed a large left pleural effusion. Following removal of the fluid, the lung fields were seen to be clear, and repeated chest examinations over the next two years failed to reveal evidence of parenchymal change. The first gastrointestinal examination was made on August 4 (Fig. 2, 8-4-48) and gross abnormality of the small intestinal pattern with enlarged and irregular valvulae conniventes, segmentation of the barium meal and a ragged appearance of segments of the small intestine were found. The small intestinal transit time was three hours. The outlines of the viscera were obscured by an over-all clouding due to fluid. The abnormal small intestinal pattern was thought probably to be due to tuberculous peritonitis. On August 10 an exploratory laparotomy was performed. The cecum and loops of the small intestine were firmly attached to a grayish, somewhat roughened parietal peritoneum. The omentum was firmly adherent to the small and large intestines in the right lower quadrant. In several areas groups of tubercles were seen.

Biopsy revealed tuberculosis of the omentum. The ascitic fluid on guinea pig inoculation was found to be positive for tubercle bacilli.

Streptomycin 0.5 gram twice daily was started on August 23 and continued for forty-two days. The patient became almost immediately afebrile and experienced marked symptomatic improvement. The abdominal distention decreased.

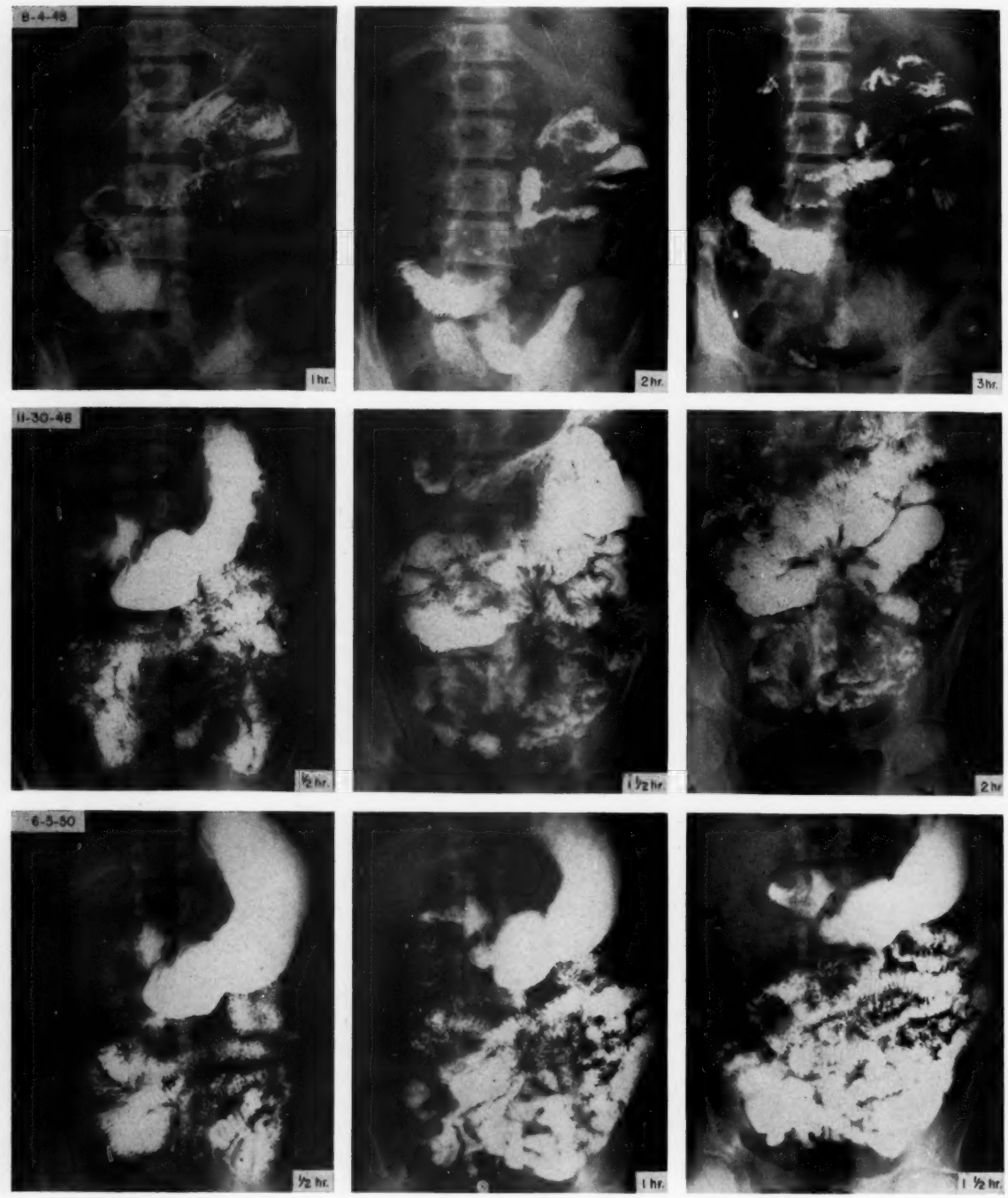

FIG. 2

8-4-48. Gastrointestinal series before streptomycin therapy showing abnormal small intestinal pattern with segmentation of the barium column, delayed motility, abnormal variation in lumen width and absence of regular mucosal markings.

11-30-48. Examination made during streptomycin therapy showing improvement in the small intestinal pattern. Abnormal features are the extreme variation in tone, loss of normal mucosal folds and delayed motility.

6-5-50. Examination made eighteen months after streptomycin therapy showing normal small intestine.

On November 30 (Fig. 2, 11-30-48) the gastrointestinal series was repeated. The jejunum was still somewhat dilated, loss of the normal outlines of the valvulae conniventes of segments of the ileum was present and some delay in the small intestinal motility was noted. Improvement of the small intestinal pattern, however, had occurred.

Following the first course of therapy, the patient had a febrile relapse and a second similar course of streptomycin was begun on December 15. He became afebrile on December 20 and remained so until discharged on July 22, 1949.

Final roentgenograms of the small intestine of June 5, 1950 (Fig. 2, 6-5-50), demonstrated a normal appearing stomach and small intestine.

Follow-up physical examination and chest roentgenograms of March 2, 1951, showed the patient to be in good health.

Case III. G.J. (R-23762), a colored male, aged twenty-six, was admitted to the Veterans Administration Hospital, Fort Howard, Maryland, on January 25, 1950. He complained of lower abdominal pain, nausea, chills, and fever, which had started suddenly three to four weeks before.

On physical examination he appeared dehydrated with evidence of weight loss. His temperature was 103° F. His abdomen was tense, with tenderness throughout the lower quadrants. Ascites was thought to be present.

Roentgenogram of the chest was negative. Material from two gastric washings was negative for acid fast bacilli.

A survey film of the abdomen made on the day of admission was suggestive of partial intestinal obstruction. A barium enema examination performed on February 9 was negative. On February 13 (Fig. 3, 2-13-50) the first gastrointestinal examination showed a dilated jejunum and upper ileum with segmentation of the barium meal and narrowing of the intestinal lumen in the distal ileum. The mucosal folds of the ileum were absent. The appearance of the small intestine indicated partial obstruction.

The clinical impression was tuberculous peritonitis and on February 21 an exploratory laparotomy was done. A large amount of ascitic fluid was found between loops of adherent small intestine, and the peritoneum and mesentery were studded with fine groups of tubercles. Biopsy showed caseous tuberculosis of the omentum.

On February 21 the patient was started on 1 gram of streptomycin daily for ninety days. Fever resolved by lysis. Symptomatically the patient was greatly improved. On March 31, 1950 (Fig. 3, 3-31-50), roentgen examination of the gastrointestinal tract demonstrated a normal appearing stomach and small intestine. He was discharged in good physical condition from the hospital on June 6, 1950.

A final examination of the small intestine with barium contrast medium was made on July 13, 1950 (Fig. 3, 7-13-50). This was the only examination following the full course of streptomycin, and the roentgen appearance of the gastrointestinal tract was considered to be entirely within normal limits.

DISCUSSION

The mechanism for the production of the altered roentgen appearance of the small intestine in tuberculous peritonitis is difficult to explain. It would seem that adhesions, damage of the intramural nervous system and obstruction of lymphatic vessels are factors which singly or in combination could account for the observed changes. Three patients of the series of 26 reported by Wichelhausen and Brown[4] had a follow-up laparotomy after completion of treatment with streptomycin. Striking gross improvement had taken place. The innumerable small nodules noted previously were not present and the extensive adhesions had almost completely disappeared. Histopathologic evidence of peritoneal tuberculosis was still found in 2 of the 3 patients. On the basis of this evidence of Wichelhausen and Brown, the improvement of the roentgen appearance of the small intestine demonstrated in our cases could be accounted for by the regression of nodules and adhesions.

Tubercles imbedded in the wall of the small intestine may affect the intramural nervous system and the disordered motor function could then be explained on a basis of damage to the nerves and nerve plexuses. The healing of the tuberculosis is probably accompanied by improvement of function of the intramural nervous system which may also explain the improvement of the

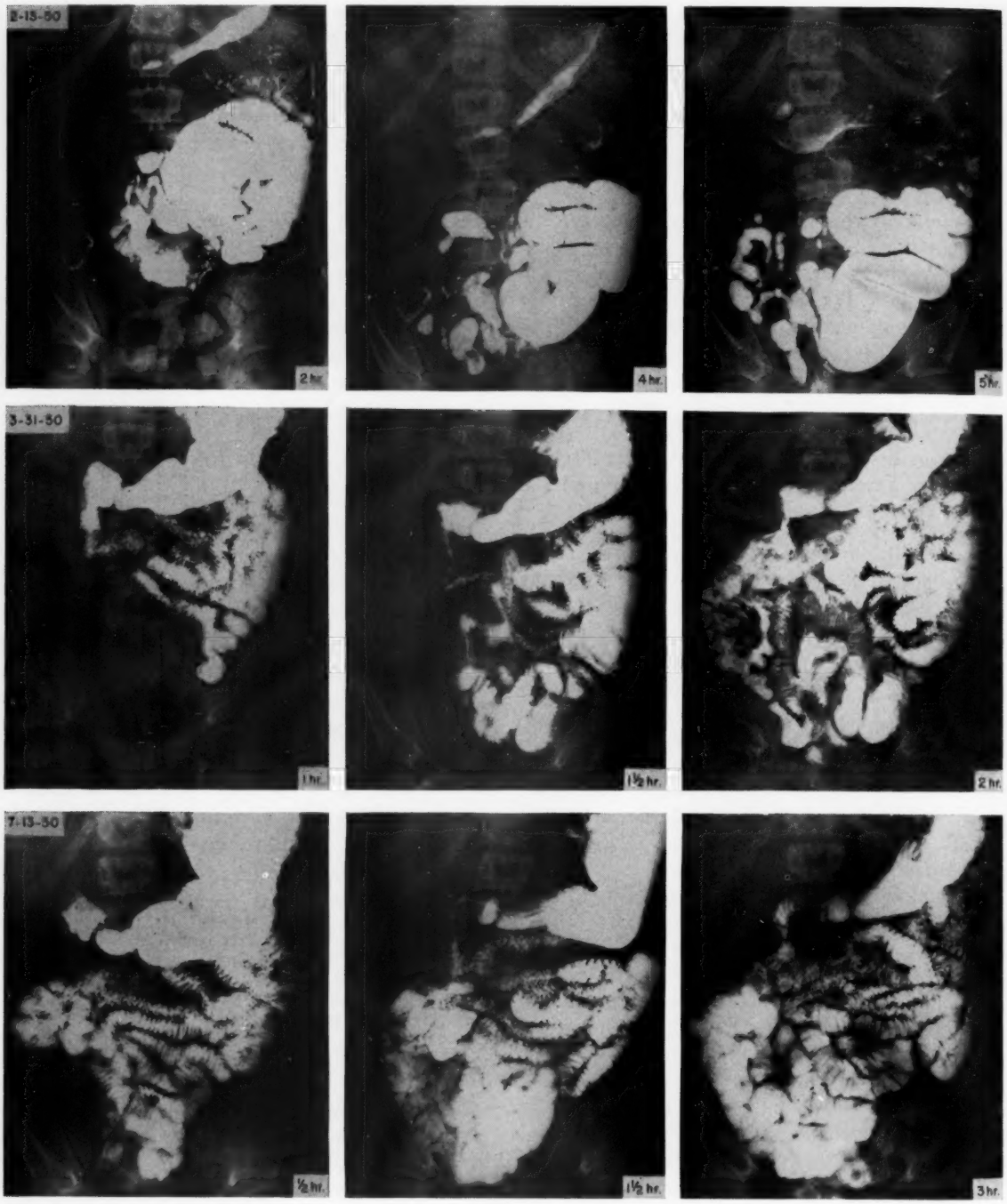

FIG. 3

2-13-50. Examination made before streptomycin therapy showing abnormal small intestinal pattern as evidenced by extreme delay of small intestinal motility, dilated loops of jejunum and upper ileum, narrowed segments of ileum with absent mucosal folds and segmentation of barium.

3-31-50. Examination performed after five weeks of streptomycin therapy showing improvement of small intestinal pattern and normal motility.

7-13-50. Examination made two months after completion of streptomycin therapy showing normal appearing stomach, duodenum, and small intestine.

small intestinal pattern after streptomycin therapy.

The commonest source of infection in tuberculous peritonitis appears to be the mesenteric nodes which become infected with tubercle bacilli. Obstruction of lymphatics and faulty absorption of intestinal contents, resulting in secondary deficiency disease, may also contribute to the production of the abnormal small intestinal pattern associated with tuberculous peritonitis.

SUMMARY

1. Three cases of proved tuberculous peritonitis with small intestinal pattern demonstrated by the barium meal, before, during, and after therapy with streptomycin, have been presented.

2. All cases showed an abnormal roentgen appearance of the small intestine. Prominent among the changes were delayed motility, segmentation of the barium meal, loss of the normal outlines of valvulae conniventes and dilatation of segments. Early in the course of the disease, roentgen changes may be absent.

3. Changes of the small intestine reflecting a disordered motor function were seen to resolve in the small intestinal pattern to be within normal limits following therapy with streptomycin. These changes paralleled the symptomatic return of the patient to normal.

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ROENTGEN DEMONSTRATION AND SIGNIFICANCE OF THE PEDICLE IN POLYPOID TUMORS OF THE ALIMENTARY TRACT*

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THE roentgen demonstration of a pedicle in association with a filling defect in the alimentary tract is pathognomonic of a polypoid tumor regardless of size[1,2] (Fig. 1). The roentgen aspects of the pedicle have been overshadowed by discussions of detection techniques and the actual or potential malignant nature of polypoid lesions. This presentation is concerned with the roentgen features of the pedicle because of its diagnostic importance.

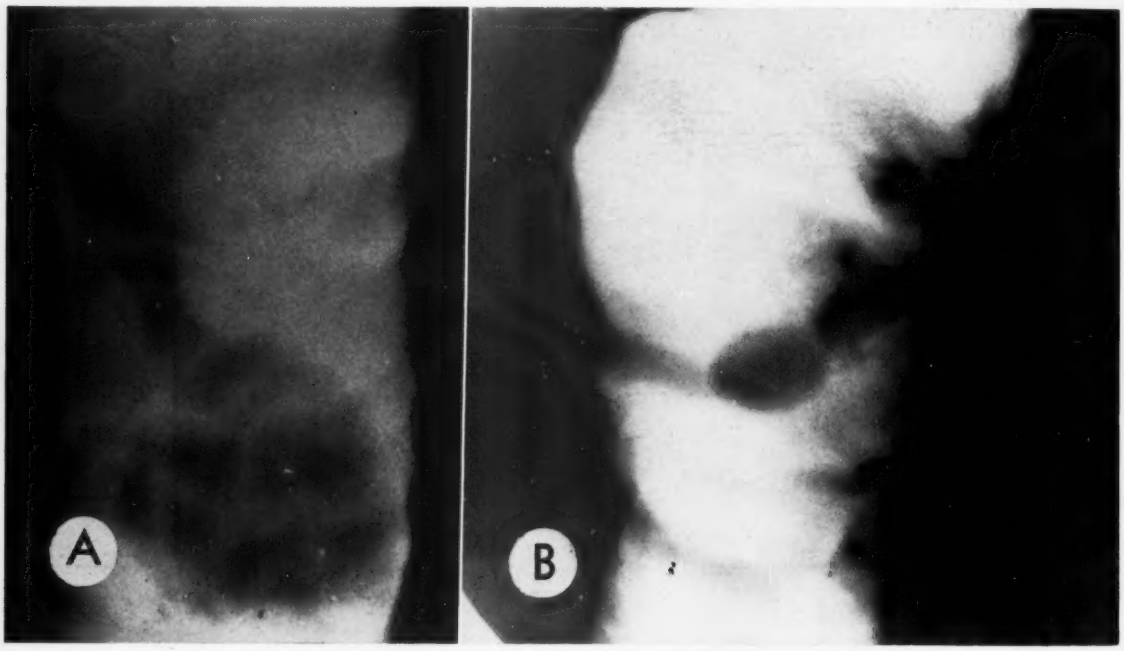

FIG. 1. Large and small polypoid filling defects (adenomas) with pedicles. Note characteristic indentation of the intestinal wall.

An understanding of the nature of the pedicle is essential in accurate evaluation and localization of polypoid tumors in the alimentary tract. The pedicle is produced by traction. The tumor is stripped away from the muscular coat a variable distance, depending upon the looseness of the submucosa and the peristaltic traction effect. During maximal traction, the attachment is elongated to form a pedicle, which diminishes and may even disappear upon lessening of traction (Fig. 2). Therefore, there is considerable variation in length and configuration of the pedicle, even in the same lesion. This variation accounts for the lack of correlation of the roentgen and surgical findings concerning the pedicle in the occasional case.

Permanency, length and configuration of the pedicle depend upon several factors, including duration and size of the mass the

* Presented at the Fifty-second Annual Meeting, American Roentgen Ray Society, Washington, D. C., Sept. 25–28, 1951.

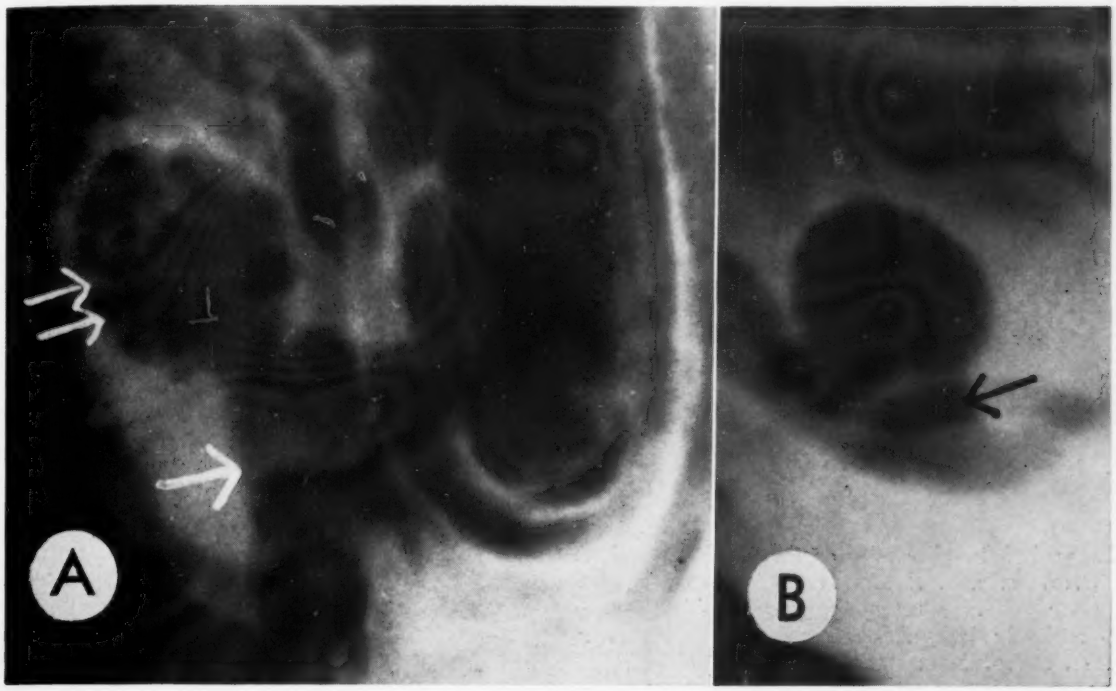

Fig. 2. Lobulated gastric adenoma (double arrows). Tenting of mucosa exaggerated by traction (*A*, arrow), and decreased by lessening of traction (*B*, arrow). Lesion was sessile and devoid of permanent pedicle at surgery.

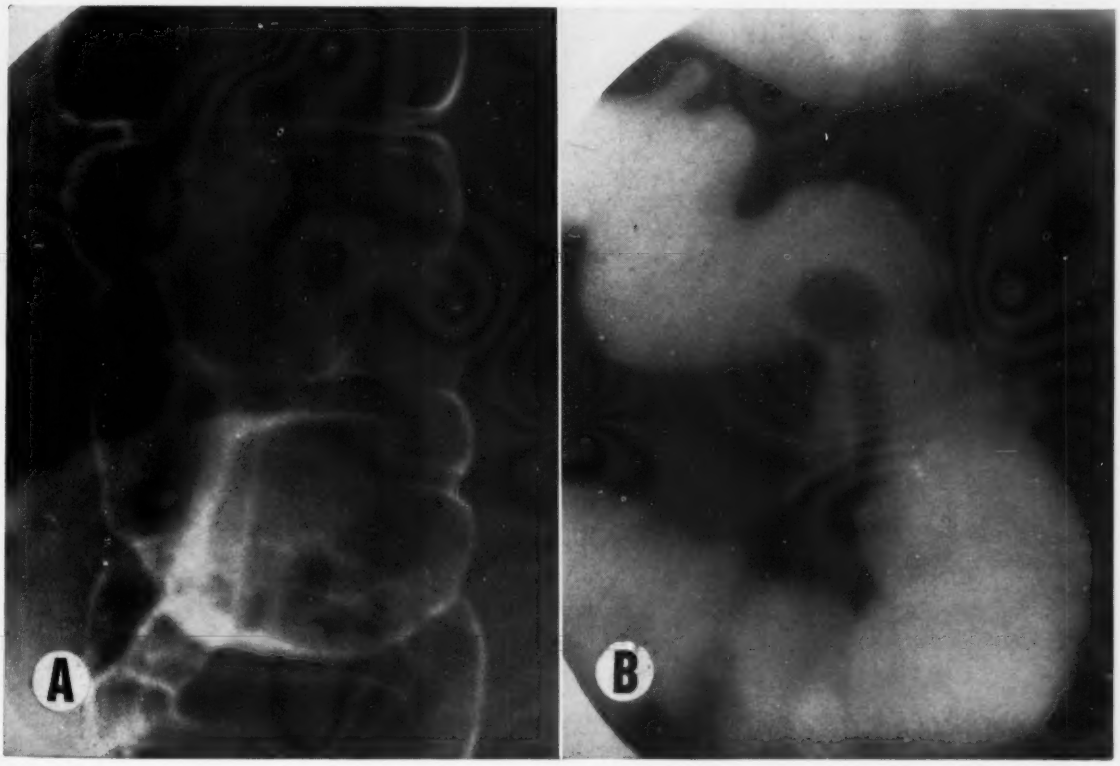

Fig. 3. Long pedicle tumors with bases of small diameter. (*A*) Adenocarcinoma. (*B*) Adenoma.

circumference of its base, the tone of the elongated tissues and the above-mentioned traction effect. In all probability, the most important factor is the circumference of the base. Tumors with long pedicles have narrow bases and those with short pedicles have broad bases (Fig. 3 and 4*B*). The diameter of the pedicle is proportionate to the width of the base. The configuration of the pedicle is either conical or cylindrical. Permanency is attributed to a loss of elasticity of the pedicle as the result of prolonged traction.

Roentgen identification of the pedicle removes all doubt as to the nature of the filling defect and is diagnostic in lesions of any size. Roentgen diagnosis is made as a rule by roentgenoscopy and spot roentgenograms. The filling defect recognized at roentgenoscopy is often caused by a combination of the pedicle and the tumor. Dissociation of the two may be obtained by optimal rotation, compression and traction, the last produced by the barium stream and manual displacement (Fig. 4).

Indentation of the intestinal wall may be the initial evidence of a pedunculated lesion and necessitates a careful search for the tumor and its pedicle[1] (Fig. 1). It is produced by traction on the wall of the intestine by the pedicle. Fluttering of the tumor in the barium stream is pathognomonic of a pedicle. Once the optimal roentgenoscopic image is achieved, compression roentgenography is used to obtain greater detail and a permanent record of the lesion.

The majority of tumors are small with a narrow cylindrical pedicle and a narrow base. Tumors less than 1 centimeter in diameter are diagnosed with accuracy when the pedicle is revealed. Precise roentgen localization of these small tumors is of extreme importance because at surgery it is often impossible to palpate them through the intestinal wall, particularly in the presence of diverticula and excessive fat. When the pedicle is long, it is necessary for the surgeon to realize that the tumor may be at a considerable distance in either direction from its point of origin. This point is indicated by indentation of the intestinal wall and therefore alteration in contour is important in localization as well as in diagnosis. Orientation is best obtained by 14 by 17 inch stereoscopic double contrast films to supplement the roentgenoscopically controlled compression roentgenograms (Fig. 5).

Broad pedicle tumors are more difficult

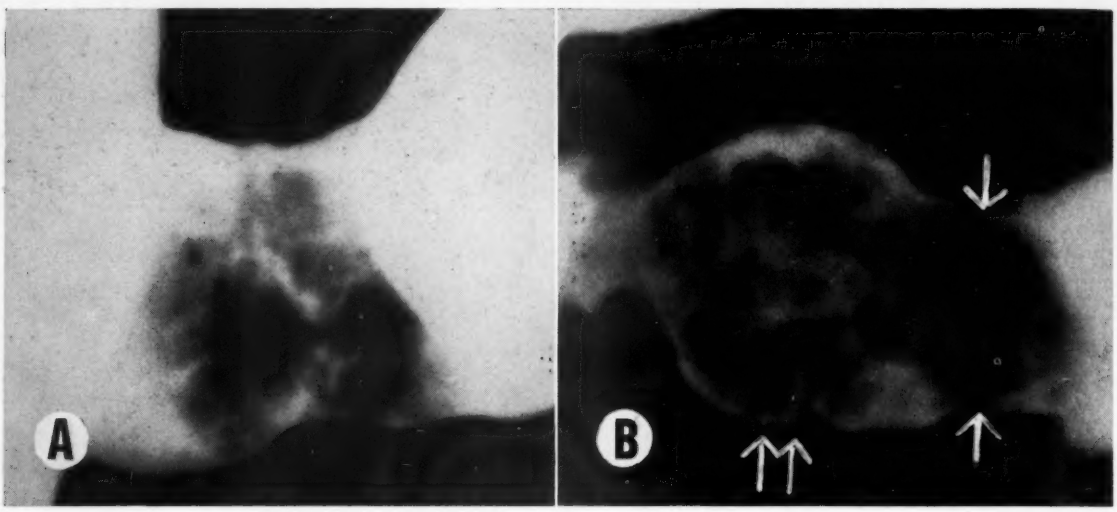

FIG. 4. (*A*) Nondescript filling defect seen end-on, produced by carcinoma. (*B*) Profile view illustrates dissociation of defect into lobulated tumor (double arrows) and its broad smooth pedicle (single arrows).

Fig. 5. Small adenoma and pedicle demonstrated on spot compression film (*A*) and localized on double contrast roentgenogram (*B*, arrow).

to evaluate. The summation of a broad pedicle and a bulky tumor causes a filling defect that simulates polypoid carcinoma or lipoma (Fig. 6). An accurate appraisal of the components of the defect is important in determining the size and nature of the lesion. Compression roentgenograms often enable differentiation of the tumor and its pedicle because the smooth contour of the pedicle is in contrast with the lobulated tumor (Fig. 4). The broad attachment of the more sessile lesions allows the production of a pseudopedicle when traction is exerted. Cessation of traction may result in disappearance of the pseudopedicle. Gastric tumors of this type occasionally prolapse into the duodenum revealing a pedicle that is not otherwise

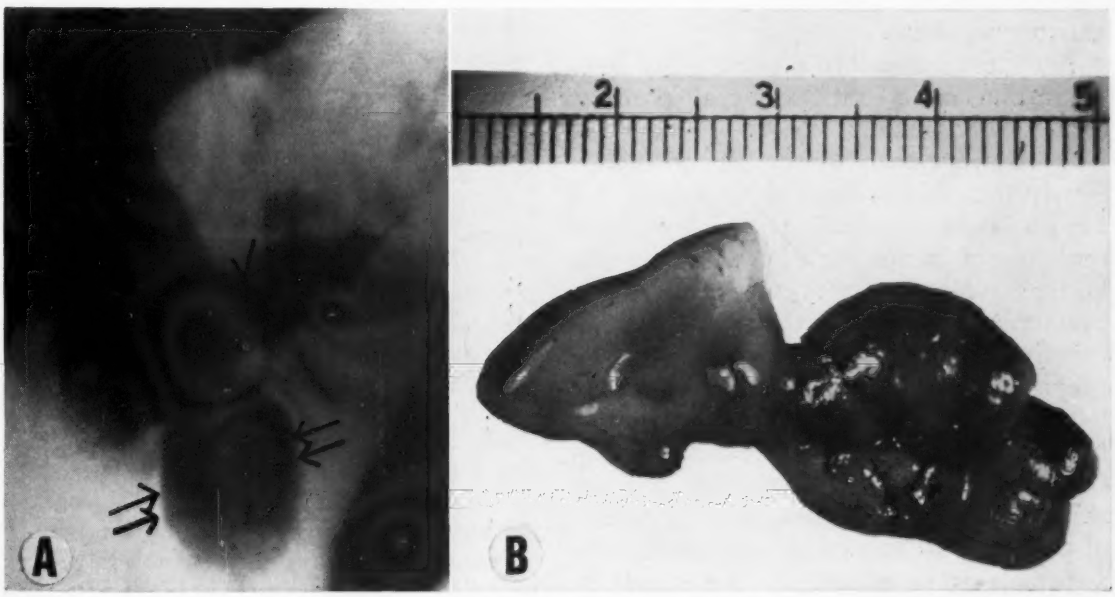

Fig. 6. (*A*) Pedicle shadow is predominant portion of this filling defect. Two centimeter adenoma and 0.5 cm. satellite are indicated by arrows. Note indentation of intestinal wall by pedicle. Photograph (*B*) reveals pedicle and attached lobulated tumor.

FIG. 7. Gastric adenoma prolapsed with mucosa through pylorus into duodenum (arrows). Lesion sessile at surgery. (Illustration courtesy of Dr. B. P. Widmann.)

seen (Fig. 7). Surgical and roentgen correlation depend upon an understanding of this phenomenon.

Artefacts are readily eliminated by demonstration of a pedicle. Fecal particles are usually readily dislodged manually and are swept away by the barium enema. Freely movable filling defects should not be dismissed as fecal material without excluding a tumor on a long pedicle. Unlimited motion and disappearance after evacuation indicate its fecal nature. Reexamination immediately or after another preparation may be necessary. Infrequently a diverticulum simulates a polypoid lesion and may necessitate re-examination. Gas bubbles may be confusing, but are readily dispersed by compression, change of position and flow of the enema. Rarely, a pedicle is simulated by the sacroiliac joint which presents a radiolucent configuration not unlike a pedicle.

SUMMARY

The roentgen demonstration of a pedicle is of great significance in the diagnosis, localization and accurate evaluation of polypoid tumors of the alimentary tract. Pedicles vary in length and configuration and are demonstrable in a high percentage of polypoid lesions. The roentgen features of the pedicle, as revealed primarily by roentgenoscopy and compression roentgenography of the optimal roentgenoscopic image, are discussed and demonstrated.

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DISCUSSION

DR. CLYDE A. STEVENSON, Temple, Texas. I take a great deal of pleasure in discussing this paper by Drs. Young and Scanlan, for refinement of diagnosis of polypoid disease of the colon is certainly a step forward in the successful prevention of death from cancer of the colon.

The roentgenologic demonstration of a pedicle attached to a polyp-like shadow relieves the roentgenologist of lots of worry and enables him to locate the tumor for the surgeon with utmost confidence.

Drs. Young and Scanlan make their diagnosis primarily by roentgenoscopy and spot roentgenograms. This diagnosis can also be made primarily by the double contrast study and I have just one slide in which I would like to show you some of those examples.

This slide shows six different polyps all of which are pedunculated. The polyps vary in size from 3 mm. to 1 cm. and the pedicle is visualized very well by the double contrast method. In three instances, the polyp may be seen on-end and gives rise to a double ring which we call the bull's eye sign. The inner ring is due to the pedicle and the outer ring is due to the outer border of the polyp itself. One of the

polyps is identified by the slight dimpling of the intestinal wall due to pull on the pedicle.

The demonstration of a long pedicle should put the surgeon on guard in regard to possible difficult location at the time of operation. Small polyps are difficult to palpate and at times our group has found that darkening of the operating room and the use of transillumination of the colon will help to locate these long, pedunculated polyps.

I would certainly like to congratulate the authors on the excellence of their presentation.

Dr. Young (closing): Although the pedicle is often demonstrable on double contrast films, we have revealed it with greater frequency and to best advantage by the combined method of roentgenoscopy and spot roentgenograms. Double contrast films are included for orientation and to exclude other lesions.

CHOLECYSTOGRAPHY

A COMPARISON STUDY OF A NEW CHOLECYSTOGRAPHIC MEDIUM AND PRIODAX IN FIFTY PATIENTS

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THE purpose of this paper is to compare the clinical and roentgenographic aspects of the use of a new cholecystographic medium—o-(4-hydroxy-3, 5-diiodobenzyl) benzoic acid§ and priodax—beta-(4-hydroxy-3,5-diiodophenyl)-alphaphenyl proprionic acid.‖ The former of these will hereafter be discussed as the benzoic acid derivative. Strain and his associates[2,3] have previously reported on the benzoic acid compound in animals and in normal human subjects. Strain found in his study of 16 normal subjects using both agents that the benzoic acid gave better roentgenographic visualization in 8 instances, that visualization was equally good in 7, and priodax gave superior visualization in one.

In addition, Strain found that the benzoic acid derivative delineated the extrahepatic ducts in 6 of his 16 cases. The benzoic acid medium caused diarrhea of varying severity in 5 of these subjects and abdominal discomfort in one. Priodax produced diarrhea in 12 and abdominal discomfort in seven. His data encouraged us to compare these agents in clinical use.

Our study is based on the clinical comparison of the benzoic acid derivative and priodax in 50 patients in whom each agent was administered in comparable and clinically acceptable dosage ranges and at intervals of no less than one week.

The patients used in this study were seen in the general medical clinic. They were selected at random, some having complaints referable to the gastrointestinal tract.

Each patient followed the customary cholecystographic procedure with films made sixteen hours after ingestion of six tablets (3 grams) of the particular medium used. Non-visualization was followed by twelve tablets (6 grams) the same day and

TABLE I

MAJOR AND MINOR SIDE EFFECTS OF BENZOIC ACID COMPOUND AND PRIODAX IN FIFTY PATIENTS

	Benzoic Acid		Priodax	
Nausea				
Mild	6	(12%)	7	(14%)
Moderate	4	(8%)	6	(12%)
Severe	4	(8%)	2	(4%)
Total	14	(28%)	15	(30%)
Vomiting				
Mild	0	(0%)	0	(0%)
Moderate	1	(2%)	1	(2%)
Severe	3	(6%)	1	(2%)
Total	4	(8%)	2	(4%)
Diarrhea				
Mild	4	(8%)	10	(20%)
Moderate	6	(12%)	7	(14%)
Severe	0	(0%)	3	(6%)
Total	10	(20%)	20	(40%)
Abdominal discomfort				
Mild	16	(32%)	5	(10%)
Moderate	1	(2%)	4	(8%)
Severe	0	(0%)	3	(6%)
Total	17	(34%)	12	(24%)
Urinary Burning				
Mild	1	(2%)	2	(4%)
Moderate	0	(0%)	2	(4%)
Severe	0	(0%)	0	(0%)
Total	1	(2%)	4	(8%)

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§ Supplied by Dr. Woodson Young of Eli Lilly and Company, Indianapolis, Indiana.
‖ Commercially available.

the roentgenograms were repeated in 9 instances.

The side effects were recorded and graded as shown in Table I.

The roentgenographic results are tabulated in Table II.

TABLE II

ROENTGENOGRAPHIC EVALUATION OF BENZOIC ACID DERIVATIVE AND PRIODAX IN FIFTY PATIENTS

	Benzoic Acid	Priodax
No visualization	5– 9.5%	5– 9.6%
Faint visualization	8– 15.1%	4– 7.7%
Fair visualization	15– 28.3%	11– 21.2%
Moderate visualization	17– 32.0%	17– 32.7%
Good visualization	8– 15.1%	15– 28.8%
TOTALS	53–100% examinations	52–100% examinations

DISCUSSION

Comparatively, the benzoic acid derivative produced fewer side effects in 20 instances, side effects were comparable in 22 examinations, and priodax produced fewer side reactions in 9 instances. No side reactions were reported following intake of both media by 17 patients. Lack of side effects was not uniform in all cases; 13 of those without side reactions with the benzoic acid derivative had side effects of varying degrees with priodax and, conversely, of those without side reactions with priodax, 6 had side reactions with the benzoic acid derivative.

Cumulatively, the total side effects of all types produced by the benzoic acid derivative was forty-six. The total produced by priodax was fifty-three. This represents more than one side effect in some patients. In further analysis, the major reactions reported were decidedly fewer with the benzoic acid derivative.

Comparison of the roentgenographic results disclosed that the roentgenographic visualization was superior with the benzoic acid derivative in 5 patients, visualization was of equal intensity in 24 cases, and that priodax gave superior results in 22 instances. The individual roentgen evaluation in Table II is based on the 50 patients in whom fifty-one comparison studies were performed.

It is worthy of note that the examinations rated as fair, moderate, and good would in nearly every instance suffice for an adequate and satisfactory diagnostic study. We then note that the benzoic acid derivative produced forty adequate studies in fifty-three examinations (75.4 per cent) and that priodax produced forty-three adequate studies in fifty-two examinations (82.7 per cent). In none of the present comparison series were we successful in delineating the extrahepatic biliary radicals.

In an attempt to ascertain the frequency of side effects purely subjective in nature, 15 ward patients were given placebo tablets* made with the same vehicle contained in the benzoic acid derivative tablets. These patients were handled and interviewed in the routine manner previously described. It is of some interest that none of these patients had any subjective complaints; however, a brief review of the literature[1,4,5,6,7,8] shows a wide variation in incidence of individual side reactions.

SUMMARY

The results obtained in a comparison series of fifty patients, each of whom received a new cholescystographic medium —benzoic acid derivative—and priodax, are discussed. These are tabulated on the basis of side reactions and roentgenographic visualization. Our conclusions are these:

(1) Side reactions were fewer in number and less severe with the benzoic acid derivative than with priodax.
(2) Priodax gave more consistent visualization of the gallbladder.
(3) Placebo tablets were given fifteen additional patients, and the same

* Supplied by Dr. Woodson Young of Eli Lilly and Company, Indianapolis, Indiana.

routine followed with no subjective complaints.

(4) The experimental cholecystographic medium offered no definite advantage over priodax in routine clinical roentgenography.

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INTRAVENOUS UROGRAPHIC CONTRAST MEDIA

A CONTROLLED STUDY OF DIODRAST AND NEO-IOPAX

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THIS comparative study was prompted by frequent and troublesome side reactions observed during intravenous urography. Two generally accepted contrast media were used: 3,5 diiodo-4-pyridone-N-acetic acid diethanolamine, commercially available as diodrast, and neo-iopax,† disodium N-methyl-3,5-diiodo-chelidamate. Their iodine content determines their radiopacity, the former containing 48.9 per cent and the latter 51.5 per cent iodine by weight. We attempted to determine under carefully controlled, similar conditions which of the two media resulted in the least untoward serious reactions to the patients, and which afforded the greater number of diagnostic urograms.

This review is based on an analysis of 2,000 of 2,200 consecutive urographic examinations of patients referred to the Department of Roentgenology of the Cleveland Clinic between January 17, 1950, and July 16, 1950. Urograms taken on hospital patients during this same period are not included. On reporting, each patient was given a "urogram record sheet" which contained space for personal data, allergic history, record of preliminary testing, reactions to the medium, and space for the grading of the diagnostic quality of the examination. These sheets were arranged alternately so that 1,100 alternate patients received diodrast and 1,100, neo-iopax.

PROCEDURE

The allergic history of each patient was recorded and, if negative, the medium was injected immediately. If a history of allergy was elicited, the patient was subjected to an intravenous test dose of the medium he was to recieve. This was given with a small syringe and consisted of 1 cc. of the medium diluted 1 part to 100 with normal saline. An interval of five minutes was allowed to elapse and if during this time no subjective symptoms were experienced by the patient, the test was considered negative and the contrast medium was then given. If subjective symptoms intervened, the test was considered positive and the intradermal skin test given as advocated by Naterman and Robins.[47] This was read in five and fifteen minutes and, if negative, again in twenty-four hours.

In an attempt to eliminate suggestibility as a factor in the production of reactions, each patient was informed only that he was to receive an injection for the purpose of making a study of his kidneys. At no time did the nurse or technician ask leading questions. If the patient spontaneously complained of discomfort the nurse or technician inquired into the details of the sensations being experienced by the patient. Objective signs were noted on the patients' sheet. Following completion of the examination the patients returned to the dressing rooms and were asked the same question, "Did the injection bother you?" Patients giving affirmative answers were questioned in detail and their responses noted on their record sheets. Neo-iopax had been used infrequently in our department. In order to avoid excessive interest and to standardize technique, 100 patients were injected with each medium before the start of the project. These first 200 records were not tabulated and are not included in the 2,000 urograms comprising this study.

The only factors which were varied in the two groups of 1,000 patients were the

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† The neo-iopax used was generously furnished by Dr. N. L. Heminway, Schering Corp., Bloomfield, New Jersey.

contrast medium and the over-all time taken for injection. It was noted as early as 1931 by von Lichtenberg,[72] in his study of uroselectan B, that general reaction was slight when a medium was injected quickly; more recently Friedman, Lobsenz and Jauernig[24] reported that the incidence of severe arm pain is greatly decreased by the rapid injection. Therefore, 20 cc. of 50 per cent neo-iopax was injected in less than one minute—usually in less than thirty seconds. From long experience with diodrast, we know that fewer systemic reactions could be anticipated with slow injection; therefore, 20 cc. of 35 per cent diodrast was injected in four to eight minutes.

Because of the exclusion of hospital patients, not many acutely or severely ill patients were studied, although no contraindications were imposed and patients with serious cardiovascular, pulmonary, renal, thyroidal, and gastrointestinal disorders were included in both groups. Prophylactic adrenalin, as used by Pendergrass,[54] or antihistaminics, as tried by Getzoff,[27] and Crepea *et al.*[17] were not administered. The patients received no form of preparation. Lower abdominal compression by means of a sphygmomanometer cuff under a canvas band was applied immediately after injection of the medium. The only patients on whom this adjunctive procedure was not used were those who could not tolerate compression; and another group was excluded because of special physical reasons (colostomy, ureterocutaneous anastomosis, pregnancy, etc.).

Films were taken five and fifteen minutes after completion of the injection. The compression device was then removed and the patient allowed to sit or stand; a seventeen to eighteen minute film was then taken to demonstrate the lower portions of the ureters more satisfactorily. A fourth large film and a small bladder posteroanterior film were taken at the end of one hour, except in patients with a clinical impression of prostatic enlargement, whose bladder film was taken at the end of thirty minutes.

The urograms may have been graded by any one of the ten roentgenologists although approximately one-half were examined by one of us (W.H.M.) The person grading them was unaware of the medium used. Three numerical grades were established as follows:

Grade IV. Excellent; urogram approaching or exceeding the expected diagnostic quality of a retrograde pyelogram.

Grade III. Good; urogram considered in all probability normal or abnormal but often indicating need for retrograde pyelography for confirmation.

Grade II. Ranging from fair to completely unsatisfactory; further study usually was indicated to exclude or confirm the presence of pathologic change.

Since no preparation of the patient was used, many probable Grade IV urograms could only be graded as Grade III or II because of obscuring gas and fecal matter; however, this condition was undoubtedly present to an equal degree in both groups.

That patient alternation resulted in closely comparable groups can be seen from Tables I and II where the personal and allergic data of the two groups is tabulated. Significant differences were analyzed by methods described in Bradford Hill's "Principles of Medical Statistics" (Lancet, London, 1945). The significance is stated in "P" values, which indicate the probability that apparent differences may have resulted from circumstance. "P" values less than 0.05 are usually accepted as indication of significant differences, since they indicate the probability of change occurrence at less than 1 in 20.

REACTIONS

Total reactions in each of the two groups are tabulated in Table III and the individual reactions with each medium in Table IV. Fewer patients demonstrating one or more local or systemic reactions were observed in the diodrast group ($P < 0.05$). Similarly, the reactions were fewer in the diodrast

Table I

COMPARATIVE PERSONAL DATA OF THE TWO GROUPS

Age Distribution by Decades									
Decade	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Diodrast	0.7%	2.6%	11.9%	18.1%	23.8%	24.5%	14.4%	4.0%	0.0%
Neo-iopax	1.0%	1.5%	10.7%	19.4%	25.1%	25.5%	13.4%	3.3%	0.1%
Average Age and Range									
Diodrast	Average Age	46.78 yr.				Range	5–80		
Neo-iopax		46.72 yr.					4–84		
Sex									
Diodrast	Men	52.9%				Women	47.1%		
Neo-iopax		51.0%					49.0%		
Race									
Diodrast	White	97.7%		Negro	2.3%		Other	0%	
Neo-iopax		97.1%			2.9%			0%	

group ($P < 0.05$). However, when only the generalized systemic reactions were considered, the neo-iopax group showed 183 as compared to 215 with diodrast. This difference is probably not significant ($P > 0.05$). Only one severe reaction was noted with neo-iopax, a local one in a patient who experienced severe pain in the arm and shoulder of five minutes' duration. This same patient developed thrombosis of the superficial veins of the arm used for injection. The phlebitis was manifested by redness, pain, local heat, and palpable thrombosis. The reaction reached its maximum in twelve hours and completely subsided in four days with only conservative management. Similar reactions have been described by Kemp.[41] In the diodrast group 6 patients suffered severe reactions, including manifestations of vasomotor collapse, respiratory distress, dyspnea, tachycardia, giant urticaria, and unconsciousness; the latter symptom occurred in 2 patients. These 6 cases were considered serious because, in each instance, the patient's life was in jeopardy for a variable period.

Twenty-four patients had two or more urograms included in the 2,000 examinations. Eleven of these had one urogram with each medium. Eight had two with diodrast, 4 had two with neo-iopax, and 1 patient three with neo-iopax. In the 11 patients with one urogram with each medium, 8 had no reaction from either. One experienced flushing secondary to diodrast but no reaction to neo-iopax. One had arm pain with neo-iopax but no reaction with diodrast. The third had no reaction to diodrast but experienced mild nausea with neo-iopax.

Local reactions, pain or burning at the site of injection or in the arm and shoulder,

Table II

ALLERGIC HISTORIES IN THE TWO GROUPS

	Diodrast	Neo-iopax
None	903 (90.3%)	898 (89.8%)
Asthma	42 (4.2%)	38 (3.8%)
Hay fever	41 (4.1%)	43 (4.3%)
Hives	20 (2.0%)	23 (2.3%)
Food	9 (0.9%)	12 (1.2%)
Diodrast	3 (0.3%)	5 (0.5%)
Drugs (other)	1 (0.1%)	3 (0.3%)
Rose fever	1 (0.1%)	1 (0.1%)
Eczema	0 (0.0%)	1 (0.1%)

TABLE III

REACTION TOTALS

	Diodrast	Neo-iopax	Both Media
Patients with no reaction	853 (85.3%)	814 (81.4%)	1667 (83.4%)
Patients with one or more reactions		186 (18.6%)	333 (16.6%)
	147 (14.7%)	186 (18.6%)	333 (16.6%)
Total individual reactions	219	258	476
Local reactions	4	75	79
Systemic reactions	215	183	397
Patients having severe reactions	6 (0.6%)	1 (0.1%)	7 (0.35%)

TABLE IV

INCIDENCE OF INDIVIDUAL REACTION IN THE TWO GROUPS

Diodrast		Neo-iopax	
Nausea	82 (8.2%)	Nausea	65 (6.5%)
Flushing	20 (2.0%)	Pain, arm and shoulder	40 (4.0%)
Vomiting	16 (1.6%)	Pain, site	35 (3.5%)
Bad taste	14 (1.4%)	Bad taste	23 (2.3%)
Hives	13 (1.3%)	Vomiting	16 (1.6%)
Warmth	12 (1.2%)	Dizziness	14 (1.4%)
Dizziness	11 (1.1%)	Flushing	13 (1.3%)
Faintness	10 (1.0%)	Warmth	11 (1.1%)
Sweating	7 (0.7%)	Faintness	10 (1.0%)
Retching	3 (0.3%)	Sneezing	4 (0.4%)
Sneezing	3 (0.3%)	Tingling and numbness of lips	4 (0.4%)
Coughing	3 (0.3%)	Headache	3 (0.3%)
Burning mouth and throat	3 (0.3%)	Pain, abdominal	2 (0.2%)
Pain or burning site of injection	3 (0.3%)	Retching	2 (0.2%)
Choking sensation	2 (0.2%)	Hives	2 (0.2%)
Dyspnea	2 (0.2%)	Burning, tongue	1 (0.1%)
Unconsciousness	2 (0.2%)	Burning, throat	1 (0.1%)
Arm pain	1 (0.1%)	Pain, chest	1 (0.1%)
Nasal stuffiness	1 (0.1%)	Pain, back	1 (0.1%)
Tingling, lips	1 (0.1%)	Pain, scapula	1 (0.1%)
Tingling, hand	1 (0.1%)	Pain, side	1 (0.1%)
Numbness, lips	1 (0.1%)	Pain, abdomen	1 (0.1%)
Difficulty breathing	1 (0.1%)	Pain, right ear	1 (0.1%)
Tinnitus	1 (0.1%)	Chilly	1 (0.1%)
Headache	1 (0.1%)	Tinnitus	1 (0.1%)
Generalized pruritus	1 (0.1%)	Coughing	1 (0.1%)
Burning, neck	1 (0.1%)	Blinking of eyes	1 (0.1%)
Stiffness, hands	1 (0.1%)	Phlebitis	1 (0.1%)
Pain, abdomen	1 (0.1%)	Coolness in veins	1 (0.1%)
Pain, chest	1 (0.1%)		

TABLE V

EFFECT OF ALLERGIC HISTORY ON INCIDENCE OF REACTIONS

	Diodrast	Neo-iopax	Both
Patients with no allergic history, having one or more reactions	125 (13.8%)	151 (16.8%)	276 (15.3%)
Patients with allergic history, having one or more reactions	22 (22.7%)	35 (34.3%)	57 (28.7%)

were much more common with neo-iopax than with diodrast ($P < 0.01$) and were due to venospasm in most cases or to direct local irritation in occasional cases where the medium extravasated. Pain in adjacent anatomic areas such as the scapula, chest, back, side, ear and abdomen may also be based on more generalized venous spasm. The occurrence of local reactions did not predispose or tend to exclude concurrent systemic reactions.

Nausea occurred in 82 (8.2 per cent) of the diodrast group and in 65 (6.5 per cent) of the neo-iopax group ($P > 0.05$). Vomiting and retching occurred with approximately equal incidence in both groups and was demonstrated in 19 (1.9 per cent) of the diodrast group and 18 (1.8 per cent) of the group receiving neo-iopax ($P > 0.05$). Probably since the nausea, retching and vomiting are the result of direct stimulation of the vomiting center, and dependent on blood level of the stimulating medium, their incidence is slightly higher with the rapid injection than with a longer period of injection.

So-called psychogenic reactions such as burning, tingling in lips, tongue, mouth and extremities, bad taste, coolness in veins, tinnitus, stiffness of hands, and so forth, were seen in 23 (2.3 per cent) of the diodrast group and in 33 (3.3 per cent) of the neo-iopax group ($P > 0.05$).

Autonomic or neurovascular symptoms such as faintness, warmth, sweating, flushing, dizziness, headache, peripheral vascular failure and unconsciousness were observed in 51 (5.1 per cent) of the neo-iopax patients and in 63 (6.3 per cent) of the diodrast group ($P > 0.05$).

True allergic type symptoms—sneezing, coughing, urticaria, difficulty in breathing, dyspnea, choking sensations, nasal stuffiness, and generalized pruritus—were seen in 27 (2.7 per cent) of the diodrast group and in only 7 (0.7 per cent) of the neo-iopax group ($P < 0.05$).

Table v correlates the incidence of all reactions with the allergic histories. With both media the incidence of reactions was significantly higher in allergic patients ($P < 0.01$). This has been noted by other

TABLE VI

INCIDENCE OF REACTION TO SPECIFIC ALLERGIC FACTORS

	Diodrast	Neo-iopax	Both
Asthma	7 of 42 (16.7%)	10 of 38 (26.3%)	17 of 80 (21.3%)
Hay fever	12 of 41 (29.3%)	14 of 43 (32.6%)	26 of 84 (30.9%)
Hives	4 of 20 (20.0%)	16 of 23 (69.6%)	20 of 43 (46.5%)
Food	3 of 9 (33.3%)	4 of 12 (33.3%)	7 of 21 (33.3%)
Diodrast	3 of 3 (100.0%)	2 of 5 (40.0%)	5 of 8 (62.5%)
Drugs	None of 1	None of 3	None of 4
Rose fever	None of 1	None of 1	None of 2
Eczema	None	None of 1	None of 1

investigators but is especially interesting inasmuch as so few of the reactions seen in either group were classified as allergic. Why an allergic history should predispose a patient to neurovascular, psychogenic or local reactions is at present inexplainable.

Table VI shows the types of allergies as elicited by the histories and the corresponding incidence of reaction. No specific predisposing allergy is apparent except in patients having a definite history of sensitivity to diodrast or those with history of urticaria who received neo-iopax. Curiously, none of this latter group of 16 manifested hives as a reaction to neo-iopax. In fact, no patient having an allergic history showed a tendency to reproduce his former allergic manifestation in reaction to contrast media.

Patients who demonstrated a definite history of sensitivity to diodrast are listed in Table VII. Reaction to one medium does not necessarily indicate a similar reaction to another medium but all 3 patients who had exhibited sensitivity to diodrast did have reactions to this medium. No evidence existed that previous single or repeated urograms have a tendency to induce sensitivity to a given medium. All reactions may represent a fairly fixed response by a particular individual organism to a particular molecular structure.

Tables VIII and IX reveal another interesting finding. In spite of an almost identical number of women and men patients with allergic histories, the women showed a definitely greater incidence of reaction to both media ($P < 0.05$). One explanation might be a lower threshold of responsiveness in women which is partially substantiated by a greater number of so-called psychogenic reactions.

Forty-one deaths attributed to urographic contrast media have been reported in the literature.[10,16,18,20,28,38,39,41,50,53,58,61,62,65,70] Many of these occurred at long intervals after the examination and in all probability

TABLE VII

SUMMARY OF PATIENTS SENSITIVE TO DIODRAST*

History	Test	Reaction
Neo-iopax patient No. 216 Hives from diodrast	Testing not done	None
Neo-iopax patient No. 342 Faintness from diodrast	Negative intravenous test	None
Neo-iopax patient No. 554 Hives, nausea, vomiting on two occasions with diodrast	Testing not done	None
Neo-iopax patient No. 673 Hives from diodrast	Negative intravenous test	Pain, arm and shoulder
Neo-iopax patient No. 1043 Nausea, vomiting and fainting from diodrast	Positive intravenous test (nausea). Negative intradermal test	Nausea
Diodrast patient No. 532 Hives and sneezing on three previous diodrast injections	Negative intravenous test	Hives, warmth and sneezing
Diodrast patient No. 542 Nausea and vomiting from diodrast	Positive intravenous test (dizziness) Negative intradermal test	Dizziness and faintness (apprehensive)
Diodrast patient No. 564 Hives from diodrast	Negative intravenous test	Nausea, vomiting and coughing

* None of 2,000 patients in the series gave a history of neo-iopax sensitivty

were due to the patient's pre-existing disease rather than to the contrast media per se. When these delayed fatalities are excluded, together with the 1 instance of sudden death during aortography reported by Pendergrass *et al.*,[53] there remain 17 instances of sudden death,[16,20,28,38,53,58,62,65,70] from attempted urography. In light of present knowledge, these 17 appear to have been due to hypersensitivity or idiosyncrasy to the medium. In all 17 instances the medium was diodrast. Since many thousands of urograms have been made with diodrast this low number of fatalities indicates a large margin of safety. We have used diodrast for more than 75,000 urograms at the Cleveland Clinic without fatal outcome. Dotter and Jackson,[21] in a recent survey of angiocardiography, reported 23 instances of death in 6,824 investigations (0.38 per cent); however, none occurred in the absence of cardiac or renal disease. Perhaps such factors as sudden cardiac strain on decompensated hearts or high concentration of medium reaching anoxic respiratory centers explain some angiocardiographic deaths. These factors are not present in the usual urographic study. So far, no instance of sudden death following neo-iopax in intravenous urography has been reported.

Without information concerning the exact number of urograms done with each medium, or information concerning unreported deaths, the statistical significance of the mortality factor cannot be determined. It would appear, however, that in the light of present knowledge neo-iopax offers an additional added margin of safety.

Minimal lethal doses for various contrast media have been studied in rats[48,49] and have been found to be 8,000 to 9,000 mg. per kg. of body weight for urokon and neo-iopax, 4,000 to 5,000 mg. per kg. for hippuran, and 3,000 to 4,000 mg. per kg. for diodrast. This information has little or no application in evaluating instances of sudden death during urography since the basic factor is probably one of sensitivity or idiosyncrasy. In the case reported by Dolan[20] only 3 cc. of diodrast was given. This wide margin of safety probably never should deprive the patient of the benefit of a needed diagnostic study any more than his chances of sudden death due to an automobile accident should prohibit his going home after the procedure.

Pendergrass[54] suggested in 1943 the prophylactic use of epinephrine 1/1000 in doses of 0.2 to 0.5 cc. From available information, antihistaminics are of no value in inhibiting reactions.[17] A drug may be found in the future which will prevent the serious reactions and even the deaths. We have used 35 per cent diodrast in approximately 750 cerebral arteriograms done under sodium pentothal anesthesia and have not seen a single instance of hives or other allergic type reaction. Convulsions have occurred on three or four occasions but it is difficult to ascertain how often this can be attributed to the diodrast. The death which occurred and was reported by Wise, Hughes and Hannan[77] was not explained definitely and may not have been due to the diodrast. Because of this exceedingly low incidence of reactions when cerebral arteriography is performed under sodium pentothal, a therapeutic trial of this drug seems indicated in severe

Table VIII

INCIDENCE OF ALLERGIC HISTORY IN THE TWO SEXES

	Diodrast	Neo-iopax	Both Media
Women	50 (10.6%)	39 (8%)	89 (9.3%)
Men	51 (9.6%)	63 (12.4%)	114 (11.0%)

Table IX

INCIDENCE OF REACTIONS IN THE TWO SEXES

	Diodrast	Neo-iopax	Both Media
Women	79 (17.6%)	113 (23.06%)	192 (19.9%)
Men	68 (12.9%)	73 (14.9%)	141 (13.6%)

TABLE X

COMPARISON OF DIAGNOSTIC QUALITY

	Diodrast	Neo-iopax	Both Media
Grade IV	284 (28.4%)	244 (24.4%)	528 (26.4%)
Grade III	443 (44.3%)	449 (44.9%)	892 (44.6%)
Grade II	273 (27.3%)	307 (30.7%)	580 (29.0%)
Average grade all urograms	3.01	2.94	2.97

TABLE XI

RELATIONSHIP OF DIAGNOSTIC QUALITY AND PRESENCE OR ABSENCE OF REACTION

	Diodrast		Neo-iopax		Both Media	
	Without reaction	With reaction	Without reaction	With reaction	Without reaction	With reaction
Grade IV	239 (28.0%)	45 (30.6%)	205 (25.2%)	39 (21.0%)	444 (26.6%)	84 (25.2%)
Grade III	338 (45.5%)	55 (37.4%)	365 (44.9%)	84 (45.2%)	753 (45.2%)	753 (45.2%)
Grade II	226 (26.5%)	47 (32.0%)	244 (30.0%)	63 (33.9%)	470 (28.3%)	110 (33.0%)
Average	2.01	2.99	2.95	2.87	2.98	2.92

TABLE XII

RELATIONSHIP OF DIAGNOSTIC QUALITY AND ALLERGIC HISTORY

	Diodrast		Neo-iopax		Both Media	
	With allergy	Without allergy	With allergy	Without allergy	With allergy	Without allergy
Grade IV	20 (20.8%)	264 (29.2%)	21 (20.5%)	223 (24.9%)	41 (20.7%)	487 (27.3%)
Grade III	37 (38.6%)	406 (44.9%)	45 (44.2%)	404 (45.0%)	82 (41.4%)	810 (45.0%)
Grade II	39 (40.6%)	234 (25.9%)	36 (35.3%)	271 (30.1%)	75 (37.9%)	505 (28.0%)
Average	2.80	3.03	2.94	2.85	2.87	2.94

TABLE XIII

EFFECT OF SEX ON DIAGNOSTIC QUALITY

	Diodrast		Neo-iopax		Both media	
	Men	Women	Men	Women	Men	Women
Grade IV	124 (23.5%)	160 (34.0%)	98 (22.2%)	147 (29.9%)	222 (21.4%)	307 (31.9%)
Grade III	238 (44.9%)	205 (43.6%)	224 (50.8%)	224 (45.8%)	462 (44.5%)	429 (44.8%)
Grade II	167 (31.6%)	106 (22.4%)	119 (27.0%)	119 (24.3%)	355 (34.1%)	225 (23.4%)
Average grade	2.92	2.11	2.82	3.05	2.87	3.08

reactions. The protective value of prophylactic cortisone in urography and angiocardiography is under investigation.

DIAGNOSTIC QUALITY OF UROGRAMS

The results of grading are seen in Table x. No significant difference in the diagnostic quality of urograms made with the two media is indicated ($P > 0.05$). The quality of the urograms was not altered by the presence of a local or generalized reaction (Table xi), or by the presence or absence of an allergic history (Table xii). The sex of the patient was not a pertinent factor (Table xiii).

In our opinion, the type of contrast medium is inconsequential to the diagnostic quality of the urogram. There are factors of much greater importance such as the use of compression, adequate preparation, adequate renal excretory function, physical proportions of the patient, technical quality of the films, and age.

Apparently these intrinsic factors are more important since in the 11 patients in which urograms were made with both contrast media the grades were identical for both media in 8, and only one grade apart in each of the other 3. A normal, well prepared patient will probably have an excellent urogram with either medium while an aged, obese person, improperly prepared, will tend to have an unsatisfactory study with either.

PRELIMINARY TESTING

We purposely selected a small intravenous test dose in an attempt to eliminate any false positive tests. In the past, we have encountered technical difficulty in administering only 0.1 cc. of undiluted medium from a 20 cc. syringe with any accuracy. Our intravenous test apparently lacks accuracy since 178 of the 198 allergic patients were subjected to this test with only 3 positive reactions (Tables xiv and xv). Conversely, many with negative tests and positive allergic histories had reactions of varying severity, including the 2 patients who lost consciousness on diodrast administration. Interestingly, 1 patient with no allergic history insisted upon being tested, was negative to the test dose, and experienced no reaction.

The value or necessity of preliminary testing for urographic procedures appears

Table XIV

RESULTS OF INTRAVENOUS TESTING

	Diodrast	Neo-iopax	Both Media
Negative tests	86	89	175
Positive	1	2	3

Table XV

SUMMARY OF POSITIVE INTRAVENOUS TESTS

	Intravenous test	Skin test	Reaction
Neo-iopax patient No. 1043	Positive (nausea)	Negative	Nausea
Neo-iopax patient No. 1897	Positive (dizziness)	Negative	Mild nausea, feeling of warmth and coughing
Diodrast patient No. 542	Positive (dizziness)	Negative	Dizziness and faintness

relatively unimportant. The main reason for testing, other than any medicolegal purposes, is to prevent the occurrence of a fatality. The 17 patients who died, as previously mentioned, received no known test procedure except for the case reported by Dolan[20] in which the lethal dose of 3 cc. given intravenously served as the test dose. These reactions resulting in death may be due to colloidal shock (anaphylactoid reaction) as described by Hanzlik.[31] He stated that this term is synonymous with drug idiosyncrasy, reaction, and crisis, and that anaphylactoid reactions are symptomatic reactions to a substance without previous sensitization or injection rather than due to the existence of true hypersensitivity. The symptoms and many of the changes are practically indistinguishable from those of anaphylactic shock. Many agents chemically and physically unrelated can precipitate these reactions. Proteins are not necessary and intravenous administration gives the surest response as in anaphylactic shock. If reactions to urographic contrast media are of this type, any method of testing will probably be valueless or, in itself, result in a severe reaction. Dotter and Jackson[21] state that, in 19 instances of death following angiocardiography in which testing procedures were performed, results were negative in every case. Although encouraging reports have been made by some authors utilizing the ocular test[5] and the intradermal test,[4,47,59] Singer[66] states that his data did not appear to indicate that either mild or moderate reaction could be predicted by the use of cutaneous or ocular test singly or in conjunction. Arens,[7] in 1946, stated it was generally agreed that none of the tests have proved satisfactory. Although no accurate statistics have been recorded, we have, in the past, attempted to screen our patients by using the intradermal, ocular, intravenous and oral tests,[20,46,51] with unpredictable and disappointing results. We attempted skin and ocular tests on patients who had demonstrated reactions in our department and found scarcely any correlation. In the light of our present knowledge and accepted methods of testing, we feel that these procedures are overrated in their ability to predict subsequent serious reactions, and probably of no value in predicting sudden death.

SUMMARY

Diodrast and neo-iopax have been compared in a controlled study of 2,000 patients. Fewer patients experienced a local or systemic reaction with diodrast than with neo-iopax. No significant difference in the incidence of general reactions was found in the two groups. Six severe systemic reactions were seen with diodrast and none with neo-iopax. Local reactions due to venospasm are much more frequent with neo-iopax. Patients with an allergic history have an increased likelihood of reaction. Allergic type reactions are significantly less frequent with neo-iopax. A reaction to one contrast medium does not necessarily indicate sensitivity to another medium. Patients with allergic history do not tend to reproduce their previous allergic manifestations. Women have more reactions than men, yet they have no greater incidence of allergic background. No significant difference in the diagnostic quality of neo-iopax or diodrast was noted. Intravenous testing, as used in this study, was of no value. It is doubtful if any of the present-day methods of testing can predict serious or fatal reactions.

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NEO-IOPAX: RELATIONSHIP BETWEEN DEGREE OF REACTIONS AND TIME OF INTRAVENOUS INJECTION*

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UROGRAPHY by the intravenous administration of iodine-containing contrast media is an essential diagnostic procedure. Several such chemical compounds are available. From a review of the literature the conclusion can be drawn that neo-iopax has, as far as is known, not caused a death attributable to its administration.[1,2,4] It was found to produce the best diagnostic urograms, when compared with the other contrast media.[3]

While relatively few general reactions were encountered, there was the disadvantage that relatively often the patients complained of pain in arm and shoulder. It varied from slight to very severe. The cause for this pain was due to faulty technique in only a minimal number of patients, when some of the solution was probably injected into the wall of the cubital vein or into the surrounding soft tissue.

In such instances the pain was primarily at the site of the injection and was rarely followed by evidence of a thrombosis. The pain which was much more commonly encountered was usually felt away from the point of entrance of the needle and in the shoulder or along the course of the vein. It was thought to be spastic in origin.

In order to evaluate the relationship between the time consumed by the intravenous reaction of neo-iopax and the severity of local and general reactions, we examined 300 consecutive patients referred for intravenous urography. They were divided into four groups of 75 patients each. In one group 30 cc. of neo-iopax was injected intravenously in thirty seconds or less; in another group, in one minute; in the third, in two minutes; and in the fourth, in three or more minutes.

After routine preparation, the patient was asked about symptoms of allergy. If such a history was obtained, 1.0 cc. of the solution was injected leaving the needle in the vein for one minute. In no case did an allergic reaction occur and the injection was continued after that interval.

In order to inject 30 cc. in a very short time a 20 gauge intravenous needle must be used, making sure that it is well within the lumen by aspiration of blood. The physician injecting the contrast material noted by observation and questioning the reaction of the patient: pain, nausea, vomiting and urticaria or erythema. All of these factors were graded from 1 to 4, grade 4 being the most severe degree.

When the neo-iopax was injected in thirty seconds or less (75 patients), no pain was noted in 81 per cent, grade 1 in 14.7 per cent, grade 2 in 2.7 per cent, grade 3 in 1.3 per cent, and grade 4 in none.

When one minute was used for the intravenous injection, 76 per cent had no pain; 17.4 per cent, grade 1; 5.3 per cent, grade 2; 1.3 per cent, grade 3; and none, grade 4.

After an injection time of two minutes, there was no pain in 52 per cent; grade 1, in 21.3 per cent; grade 2, in 17.4 per cent; grade 3, in 6.6 per cent; and grade 4, in 2.7 per cent.

When the contrast medium was injected in three or more minutes, 40 per cent of the patients had no pain; 29.3 per cent, grade 1; 9.3 per cent, grade 2; 18.4 per cent, grade 3; and 4 per cent, grade 4.

Some degree of nausea was present in 20 per cent of the patients when a thirty second injection was done; the percentage decreased with increasing the injection time. When three or more minutes were

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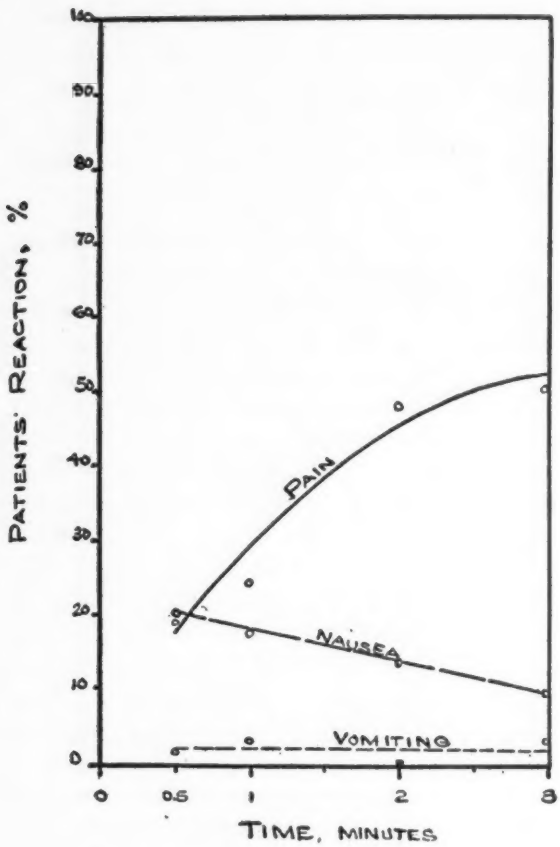

FIG. 1. Reactions to time of injection.

used for injection, only 9.5 per cent complained of this reaction, which was at no time very severe or lasting.

Vomiting was not seen often and occurred in about 2 per cent, apparently not dependent on the injection time.

Urticaria and erythema and other skin manifestations were not encountered in any of the four groups of 75 patients each (but has been seen rarely before and after this series of urograms).

When plotting these figures on graphs (Fig. 1), it becomes evident that any pain (grade 1 to grade 4) increases in percentage frequency directly proportional to the time consumed by the intravenous injection of neo-iopax. Nineteen per cent of the patients have some pain after an injection time of thirty seconds, 24 per cent after a one minute injection, 48 per cent after a two minute injection, and 50 per cent after an injection time of three minutes or more.

It is also noted that nausea (any degree) decreases from a frequency of 20 per cent after a thirty second injection to 9.5 per cent after a three minute injection.

If the percentage of patients with no pain, with slight pain (grade 1 and 2), and with severe pain (grade 3 and 4) is plotted against the four different injection times (Fig. 2), it can be shown that the number of patients with no pain decreases from 81 per cent after a thirty second injection to 50 per cent after a three minute injection. The percentage of patients with slight pain increases from 18 per cent after the fast injection to 48 per cent after the slower injection. Only 1.3 per cent of the patients had severe (grade 3 and 4) pain when the injection was done in thirty seconds; but when the injection time was three minutes or more, 22 per cent of the patients had severe pain.

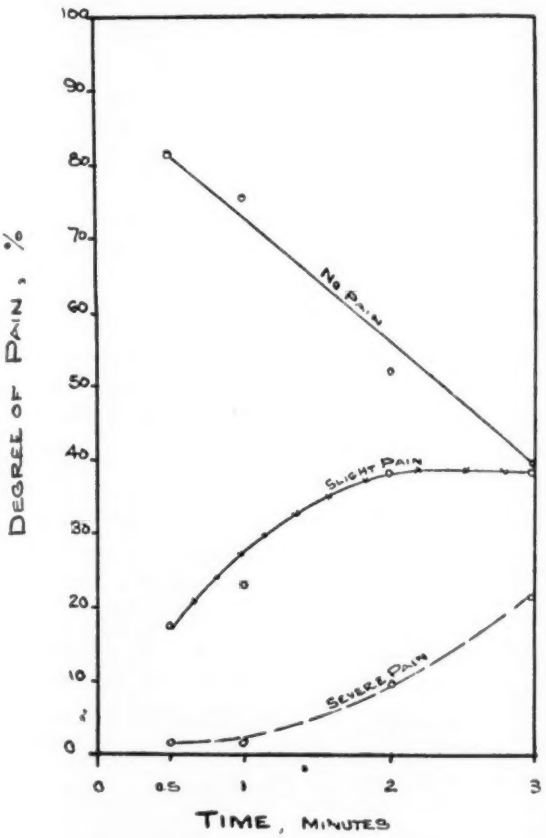

FIG. 2. Relationship between pain and time of injection.

CONCLUSION

There exists a definite relationship between the time of the intravenous injection for urography of the contrast medium, neo-iopax and the occurrence and severity of pain in arm and shoulder.

The intravenous injection of neo-iopax in about thirty seconds markedly decreases the occurrence of this reaction.

The intraveneous injection of neo-iopax done in about thirty seconds is as safe as an injection done in two or three minutes or more.

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CALCINOSIS IN SCLERODERMA

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CALCINOSIS is a rare disease in which the salts of calcium are deposited in the skin, subcutaneous tissues and sometimes the muscles and tendon sheaths. When the deposition of the calcium is limited to special areas of the skin and subjacent tissues, the disease is designated by some authors as "calcinosis circumscripta."

Localized deposits of calcium in the skin of the hands were first described in 1878 by H. Weber who thought that this disease was a form of gout. Profichet in 1900 showed the relationship between the deposition of calcium and the underlying pathology. However, it remained for Thiebierge and Weissenbach in 1905 to show the relationship between calcinosis and scleroderma and the other disorders of tissues of mesodermal origin.

INCIDENCE

There have been approximately 150 cases of so-called calcinosis circumscripta reported in the literature. Eighty-two per cent occurred in females and 18 per cent in males. The age of the patients has varied, but this manifestation of calcinosis occurs predominarntly in the thirty-five to fifty-five year group. (This is in direct contrast to calcinosis universalis which occurs predominantly in children.) Of the total number of cases reported, 40 per cent showed evidence of scleroderma. (It is interesting to note that in those patients with calcinosis universalis, the incidence of scleroderma is approximately 32 per cent.)

PATHOLOGY

The pathological changes in calcinosis are well known. This disease is characterized by the deposition of calcium posphate and calcium carbonate in the skin and subjacent tissues. Associated with these deposits are pathological changes in the surrounding tissues. The microscopic examination of the tissues involved shows perivascular infiltration of mononuclear cells, obliterative endarteritis and hypertrophy of the collagenous connective tissue. The changes grossly result in a generalized fibrosis with impairment of the blood supply and subsequent necrosis. It is in these areas of fibrosis that the typical deposition of the calcium salts occurs. The members of the "humoral school" maintain, on the other hand, that changes in blood calcium and phosphorus explain the deposition of the calcium salts. There is no analytical support for this view, however, since repeated studies of blood and urine calcium and phosphorus have shown normal levels. There have been no abnormal phosphatase levels reported.

DIAGNOSIS

It is impossible to discuss the signs and symptoms of calcinosis without stating again that this abnormality is a terminal manifestation of degenerative disease of tissues of mesodermal origin. Those signs and symptoms of scleroderma, lupus erythematosis, periarteritis nodosa and the rheumatic states will have preceded the deposition of calcium salts in their respective occurrences.

The diagnosis of calcinosis in scleroderma by roentgen study is a simple matter. The appearance of the calcium deposits in the skin and subjacent tissues is characteristic. The deposition of the calcium usually begins in the skin of the fingers. It usually first appears at "pressure points," *i.e.*, the flexor surface of the skin at the tips of the fingers. The deposits of calcium salts may also rarely appear at the elbows and knees. The condition is differentiated from myositis ossificans in that in the latter there is formation of new bone, rather than

the simple deposition of calcium salts. In hyperparathyroidism there is marked osteoporosis of the skeletal system. The deposition of calcium is seen in those organs which excrete calcium, *i.e.*, the parenchyma structure of the respiratory and urinary system. Analytical studies of the calcium and phosphorus levels in the blood, urine and feces are of no value in the diagnosis of calcinosis.

TREATMENT

Although many forms of therapy have been applied, none has met with success. Because of the relatively benign, slowly progressing nature of this disease, no radical measures are justified. It has been found, however, that surgical removal of the plaques of calcium has been helpful. This is especially true where the calcium salts are deposited in the tendon sheaths and interfere with joint function.

Various hormonal preparations have been tried in an empirical manner. The success of treatment with these preparations has not been noteworthy.

Parathyroidectomy has been used as a therapeutic measure. This procedure has met with universal failure as would be suspected from a logical study of the pathogenesis.

Ketogenic diet has been used with limited success. This method has been successful in some cases of calcinosis interstitials in young patients. It has been of no value in the therapy of other forms of calcinosis.

REPORT OF CASES

Case 1 (V.U.H. No. 156994). Third Vanderbilt University Hospital. Admission of this forty-four year old white female who had complained for four years of intermittent swelling of the large joints. For the past two years the patient had noted "drawing" of hands. For three years there had been blueness of hands on exposure to cold. Sixteen months before admission the patient noted extrusion of calcareous material from a sinus in the skin of the fourth finger left hand.

Physical Examination. Examination was negative except for the changes in the upper extremities (Fig. 2). Here there was dryness and hardness of the skin which had a parchment-like appearance. There were marked contractural deformities of the fingers of both hands. There was one draining sinus on the medial aspect of the fourth finger on the left.

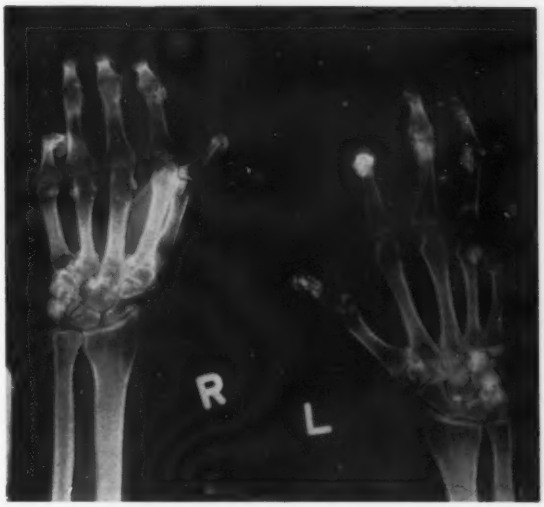

Fig. 1. Case 1. Marked deformity of the hands is noted. These films show deposition of calcium salts in the soft tissue of both hands. There is auto-amputation of the terminal phalanx of the third finger on the left. Note the deposition of calcium in skin at pressure point of thumb on left. There is also deposition of the calcium at various points throughout both hands.

Laboratory Findings. Routine blood and urine studies were within normal limits. Serum calcium, 10 mg. per 100 cc.; serum phosphorus, 2.8 mg. per 100 cc.; alk. phosphatase, 4 Bodansky units; uric acid, 4 mg. per 100 cc. Leprosy smears from the draining sinus showed

Fig. 2. Case 1. Photograph of hands showing marked flexion deformity of all fingers of both hands. The shortening of the fingers is evident.

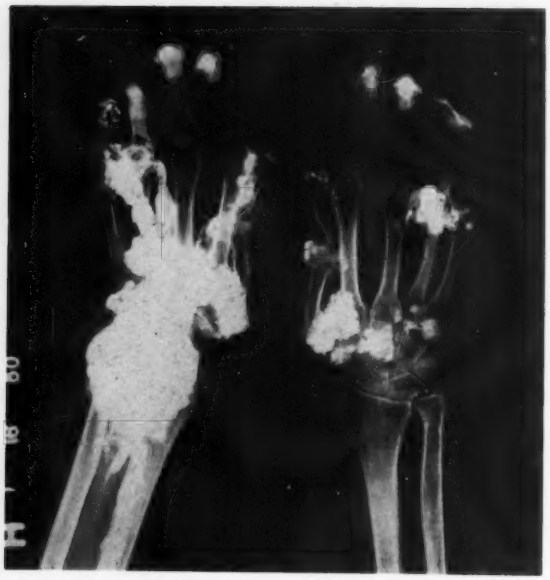

Fig. 3. Case II. Shows extensive dense deposition of calcium salts in the skin and subjacent tissues. There is extensive involvement of the flexor tendon sheaths on the left. There is autoamputation of the terminal phalanges on the first three fingers in both hands. Subluxation of the first metacarpals are seen bilaterally.

Fig. 4. Case II. Lateral view to show the distribution of the calcium salts along the tendon sheaths.

no evidence of acid fast bacilli. The electrocardiogram showed no abnormalities.

Roentgen Findings (Fig. 1). There are marked contractural deformities of the joints of the fingers in both hands. There is autoamputation of the distal phalanx of the left third finger and of the distal phalanges of both thumbs. The marked narrowing of the joint spaces in the fingers is apparent. Marked irregularity with sclerosis is noted in the terminal phalanges. The most remarkable roentgen change noted here is the deposition of calcium in the soft tissues of the hands. There is a stippled calcification noted particularly in the skin overlying "pressure points." This is particularly evident in the thumbs. There is also noted moderate periarticular calcification. There is no calcification noted in the tendon sheaths.

Case II (N.G.H. No. 24300). This was the eleventh Nashville General Hospital admission of this sixty-seven year old white female who had had painful progressive "arthritis" in both hands for eight years. There had been periodic discharge of calcareous material from sinuses in the hands for three years. (This had led to a diagnosis of osteomyelitis.) There had been progressive dryness of the skin over the digits with hardening of the skin.

Physical Examination. General condition was poor. There were areas of achromia of the skin over the sternum. The remarkable changes were found in the upper extremities where there were marked contractural deformities of the digits. There were large indurated plaques which could be palpated beneath the skin. There were no draining sinuses at the time of this examination.

Laboratory Findings. Routine blood and urinalysis were negative. Biochemical studies were as follows: phosphorus, 3.8 mg. per 100 cc.; calcium, 9.5 mg. per 100 cc.; creatinine, 1.1 mg. per 100 cc.; Kahn test, negative. Electrocardiogram showed evidence of mycoardial damage.

Roentgen Findings. Examination showed marked contractural deformities of fingers of both hands (Fig. 3 and 4). The deposition of calcium salts was especially evident along the flexor tendons of the hands. The terminal phalanges are smaller at their tips than usual.

Case III (V.U.H. No. 158550). Fifty-three year old white female admitted to Vanderbilt University Hospital with a five year history of

inelasticity of the skin of the hands. For two years before admission she had noted blueness of the hands during cold weather. The remainder of the history was negative.

Physical examination was negative except for skin and extremities. The skin of the trunk, neck and shoulders showed a brownish pigmentation. The hands showed clubbing of the fingers with sclerodactyly. There was tenseness with dryness of the skin over the hands.

Laboratory Findings. Routine studies were within normal limits. The Kahn test and urinalysis were negative. Serum calcium, 10.4 mg. per 100 cc.; serum phosphorus, 3.5 mg. per 100 cc.

Roentgen Findings. The terminal phalanges are smaller in their tip than usual. The tuft portion has disappeared. The remaining portion of the phalanges are pointed and there are scattered deposits of calcification in the soft tissues adjacent to the terminal end of the middle phalanx of the second finger medially and in the terminal end of the third finger (Fig. 5).

FIG. 5. Case III. Films of hands showing disappearance of the tufted portion of the terminal phalanges of the right hand. The same condition is seen in all the fingers except four and five on the left. The remainder of the bony structure shows no abnormality. There is para-articular calcification at the medial aspect of distal interphalangeal joint of the second finger on the right. No other soft tissue change can be identified.

SUMMARY

Calcinosis is a rare disease in which the salts of calcium are deposited in the skin and subjacent tissue. The exact mode of deposition of the salts of calcium is not understood. Calcinosis is closely allied with scleroderma and the other "mesodermal derivative" diseases. In 40 per cent of all cases of circumscribed calcinosis, scleroderma was found to have been present. The majority of the patients with this disease have manifestations of peripheral vascular disease. The disease occurs predominantly in women at menopause.

Three cases of circumscribed calcinosis associated with scleroderma have been presented.

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CENTERS OF OSSIFICATION OF THE SKELETON*†

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NEW YORK, NEW YORK

IN 1931 Camp and Cilley published, in the form of a chart, diagrams of the ossification centers of the human skeleton. The diagrams included figures giving the average time of appearance and the time of fusion according to the best information available at that time.

Appraisal of the degree of skeletal maturation is often necessary in medicine and a knowledge of the location and appearance of centers of ossification is prerequisite to the detection of fractures of growing bones.

An estimation of skeletal development is usually attempted by making roentgenograms of parts of the body where centers of ossification are growing and by compar-

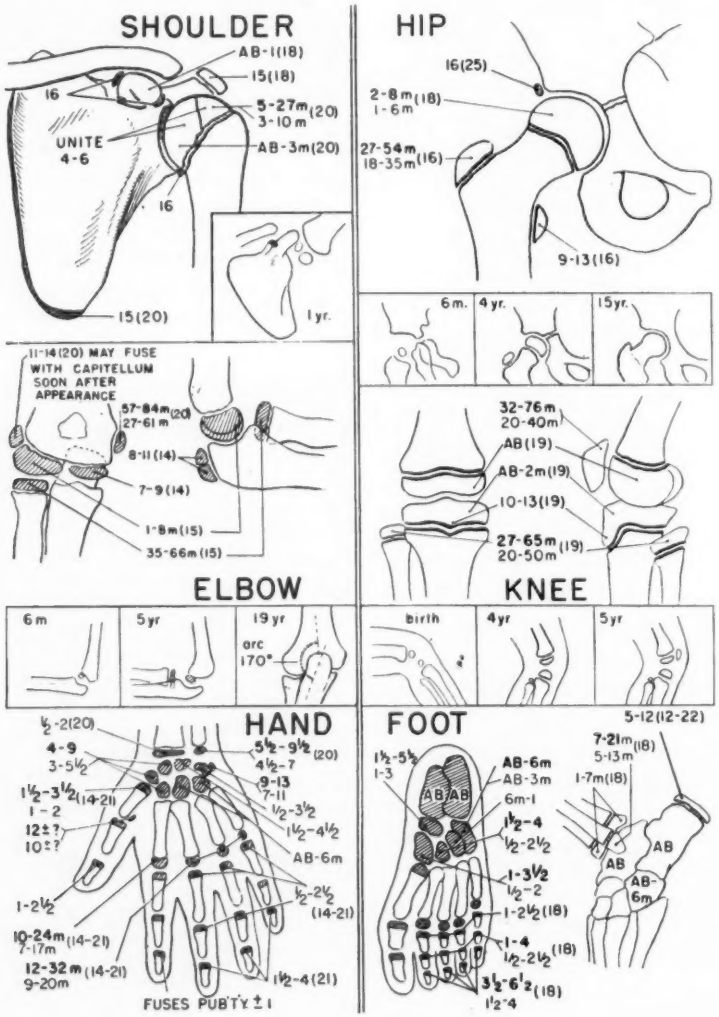

CHART I

* From the Departments of Pediatrics and Radiology of the College of Physicians and Surgeons of Columbia University, and the Columbia-Presbyterian Medical Center, New York, New York.

† Reproduced by permission from "Roentgenologic Diagnosis of Diseases of Bones." By David G. Pugh. Williams and Wilkins Company, Baltimore, Maryland, 1952.

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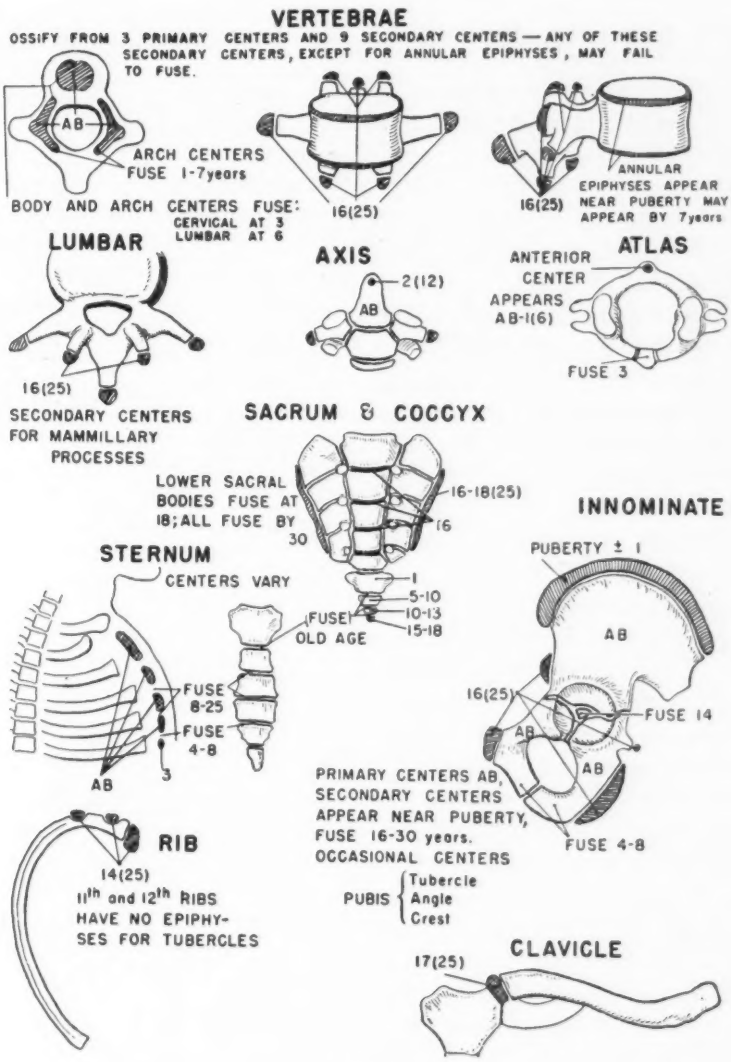

Chart II

Charts I and II.* The figures indicate the range from the 10th to the 90th percentile in appearance time of centers of ossification, obtained from the studies on bone growth available in 1950. Statistically significant studies of the time of appearance of ossification centers have been made of relatively few portions of the skeleton after the sixth year of life. Figures followed by "m" mean months, otherwise all numbers indicate years. Where two sets of numbers are given for one center of ossification, the upper heavier figures refer to males and the lower lighter figures refer to females. A single set of figures applies to both sexes. "AB" indicates that the ossification center is visible at birth. Figures in parentheses give approximate time of fusion.

* Enlarged copies of these charts, suitable for framing or for desk use, can be obtained from Williams and Wilkins Company, Mt. Royal and Guilford Ave., Baltimore 2, Maryland.

ing them with available standards based on studies of large numbers of normal individuals. The time of appearance of centers of ossification differs considerably in the two sexes, and even in the same sex normal individual variation is great. An evaluation of the ossification age of any individual must take into account these variables.

The methods recommended by Sontag *et al.* and by Elgenmark of counting the ossification centers visible on roentgenograms of half of the skeleton are particularly useful during infancy and may be applied through the sixth year. These meth-

ods avoid reliance upon any single small group of centers during an age period when variation in their time of appearance is great. Should the technique of skeletal survey be impractical for any given case, estimation of bone age in infancy can be made by comparing a single roentgenogram of the hand or the foot with the diagrams of Stuart and of Vogt and Vickers.

The standards for the hand and wrist set up by Flory, by Todd, and by Greulich and Pyle are most useful after infancy. They emphasize factors such as the size and configuration of centers of ossification of epiphyses and carpal bones. Considerable experience with these standards is necessary before they can be used with accuracy.

Statistically significant studies of the time of appearance of ossification centers have been made of relatively few portions of the skeleton after the sixth year of life, In general, the time of fusion of epiphyses, with the exception of those of the hand, has not been adequately investigated.

Because the chart method employed by Camp and Cilley has proved to be so useful, and because it presents the diagrams in the same way the shadows appear on roentgenograms, revision of the chart in the light of the additional information which has been accumulated during the past two decades seems worth while (Charts I and II). The figures giving the range in time of appearance of the most important ossification centers are taken from the work of Vogt and Vickers, Scammon in Morris' "Human Anatomy," Milman and Bakwin, Buehl and Pyle, Ruckensteiner, and Bailey.

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CLINICAL RESULTS FOLLOWING DIFFERENT METHODS OF RADIUM APPLICATION USED IN THE TREATMENT OF CERVICAL CANCER FROM 1921 TO 1947*

By MacDONALD BONEBRAKE, ALFRED I. SHERMAN, MICHEL TER-POGOSSIAN, *and* A. NORMAN ARNESON

SAINT LOUIS, MISSOURI

COMPLICATIONS encountered in therapy of cancer of the cervix uteri have always been an important factor in evaluating methods of treatment. Urinary complications and inability to remove all the involved tissues have been the primary limiting factors in surgical treatment. Injury to the skin, rectum, bladder and small intestine have comprised the more serious sequelae of radiation therapy. Ionizing radiations, by their inherent nature, are traumatic to tissues. Abnormal, as well as normal tissues are affected, but in general the effect is more marked upon the malignant growths. The greater probability for recovery of normal tissues makes practical the clinical application of radiation. However, the differential in reaction between cancerous and normal tissues presents a narrow margin of safety. Selecting quantities of radiation that fall within these narrow limits is the major problem in therapy.

In considering methods of treatment, the incidence of complications and survival statistics present evidence by which the method must be evaluated. Comparative analyses of survival statistics of radiation and surgical treatment are inconclusive. Surgical treatment to date has, for the most part, been confined to patients with very early disease and in this group the results of the two methods are very similar. Failure of cure in the more advanced stages of the disease and complications encountered in treatment of all stages has tended to make the comparison an unfavorable one. The application of surgical techniques in more advanced lesions will undoubtedly lower the over-all survival statistics for that method.

The clinical features of complications occurring as a result of irradiation injury have been well described by many authors.[1,2,3,4,5,6,8,10,11,13] Some of the very earliest publications describing the treatment of cervical cancer with radium took cognizance of injuries apt to occur. With the introduction of deep roentgen therapy new complications were encountered, and as advancements in treatment were made, the sequelae accompanying these were recorded in the literature.

In addition to total dose, other important factors to be considered in radium treatment include intensity of irradiation, duration of treatment, method of application and filtration. Attention to these factors in the technique of treatment has been responsible for the gradual decrease in the incidence of complications as well as improvement in clinical results. Initially radium and then roentgen rays were applied on a basis of empiricism without satisfactory information as to the biological reactions taking place. Gradually, however, levels of tolerance for normal and cancerous cells have been established. As clinical experience grew, new techniques were devised in an attempt to apply more uniform distribution of radiation throughout the tumor and concomitantly eliminate accompanying sequelae.

The aim of radiation treatment is to deliver a cancerocidal dose to the tumor bearing tissues with a minimum of damage to normal structures, such as skin, bladder, rectum and tumor bed. To obtain this aim,

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it is necessary to know the amount of radiation required to deliver a cancerocidal dose and the effect to be expected upon all tissues irradiated by known amounts of radiation.

A study of these irradiation effects has been made by reviewing the patients with cancer of the cervix uteri treated on the ward service of the Barnes Hospital between the years 1921 and 1947. The 490 patients included in this study have been recently. For the entire series of 490 patients, 15 per cent were classified Stage I, 43 per cent, Stage II, 34 per cent, State III and 8 per cent, Stage IV (see Table I).

The patients have been studied from the standpoint of method of treatment, complications, and survival rate. The different methods of treatment have been reconstructed and temporarily applied in patients to measure specifically the radiation delivered to the bladder and rectum. The

TABLE I

CLASSIFICATION OF PATIENTS ACCORDING TO STAGE OF DISEASE IN THREE TREATMENT PERIODS DURING 1921 TO 1947

League of Nations Classification	1921–1931		1932–1936		1937–1947		Total	
	Number of patients	Per cent	Number of patients	Per cent	Number of patients	Per cent	Number of patients	Per cent
I	7	8	15	12	52	19	74	15
II	34	41	47	39	132	47	213	43
III	30	37	54	44	81	28	165	34
IV	12	14	7	5	19	6	38	8
TOTAL	83	100	123	100	284	100	490	100

selected from a larger group treated during this period. Those with previous surgical or radiation treatment have been excluded. The patients here reported have been followed for five years in the clinic except for those treated in 1947 where a four year record is available. The League of Nations Classification has been used since 1937. All patients treated prior to that time have been reclassified to conform with the present method of staging tumors. There has been a steady rise in the number of patients treated. In the initial ten years of treatment, 83 cases of primary cervical cancer were admitted for therapy. In the 1932 to 1936 period, 123 patients were treated and 284, from 1937 to 1947. The division of patients has been made in order to study them according to the method of treatment. During the twenty-six year period from 1921 to 1947, inclusive, the incidence of Stage I lesions advanced from a low of 8 per cent at the outset to 19 per cent more

instrument used for these measurements of radiation dosages is a scintillation counter, constructed by one of the authors (M.T.P.) and demonstrated in Figure 1.

The principle of this apparatus is based on the capacity of certain crystals to emit flashes of light or scintillations when struck by ionizing radiations. The rate of scintillation thus emitted by the crystal is proportional to the rate of the impinging ionizing radiation. These flashes of light are detected by a photomultiplier tube and recorded as an electric current. The crystal used in the instrument described is an anthracene crystal. The volume of this crystal is approximately 4 cubic millimeters. It is placed in the tip of a hollow metal probe, 17 cm. long by 3.0 mm. outside diameter. Figure 2 presents the manner in which this probe is inserted directly into the rectum or bladder to obtain the measurements. A lucite rod attached to the crystal transmits light through the probe to a

photomultiplier tube placed in the handle of the instrument. Electric impulses thus generated by the photomultiplier tube are conducted by a wire to an electronic circuit, amplified, integrated and read on a voltmeter. The detector is water tight and may be sterilized by immersion in an alcoholic solution. The voltmeter reading is a relative measure of intensity. The instrument is calibrated before each measurement by placing a known radium source at a known distance from the crystal. Thus, the voltmeter reading can be interpreted in terms of roentgens per minute or per hour. This figure multiplied by the total time of irradiation gives the total number of roentgens delivered to a given point. For our

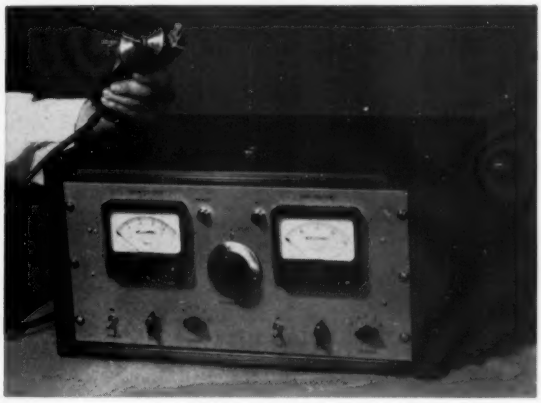

Fig. 1. Electronic circuit, probe and photoelectric tube. Scintillating crystal is enclosed within tip and the photomultiplier tube is incorporated into the handle of instrument.

specific needs the small size and convenient shape of this instrument has many advantages over the conventional ionizing chamber (Victoreen type): (1) The small size is an important factor in radiation measurements at short distances from radioactive sources. Since the intensity of radiation varies rapidly with the distance from the source a large detector will not give a true picture of radiation distributed to selected points. (2) Instantaneous reading of the intensity of radiation on a dial allows rapid measurements, minimizing discomfort to the patient and danger to the operator.

In addition calculations were made of the doses obtained at points A and B (Manchester system)[7] by reconstructing

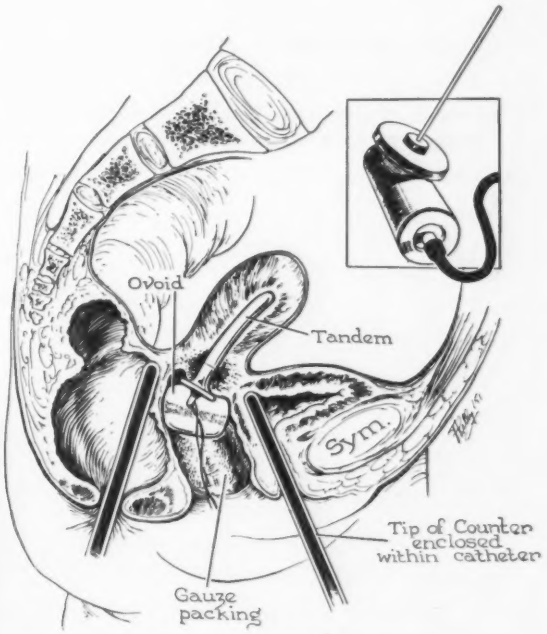

Fig. 2. Diagrammatic demonstration of counting device within bladder and rectum. Radium in place.

the distribution of radium sources applied to the patients treated previously. With these determinations of doses delivered at points A, B, rectum and bladder, an attempt was made to correlate method and duration of treatment, incidence of complication and survival statistics.

It was found convenient to divide the patients into three groups according to the plan of treatment received. During the first ten years treatment was almost entirely by radium. The contribution from roentgen rays was small in comparison with quantities used in later years. High intensity tandems of 75 to 100 mg. were introduced into the uterine cavity without the use of vaginal sources. Larger amounts of radium were placed in the cervical end of the tandem. Usually a 25 mg. source with an active length of 1.5 cm. was placed

in the fundus and a 75 mg. source with 2.5 cm. active length in the cervix. Filtration consisted of 0.5 mm. platinum. The average total dose was on the order of 3,000 milligram hours applied at one sitting. Figure 3 is a diagram of the radium distribution in the 1921 to 1931 period. The dose at point A is 5,000 to 7,000 gamma roentgens. This quantity is within the tolerance of the paracervical triangle, and by present standards this intensity of treatment represents a cancerocidal dose. With this tandem arrangement the dose at point B, however, falls to 1,000 gamma roentgens and could not be expected to control tumor in that area.

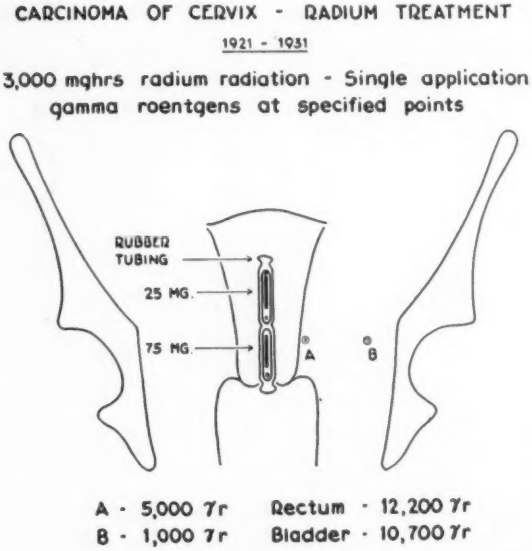

FIG. 3. Method of radium treatment in 1921–1931 period. Entire dosages delivered with one thirty hour application.

Using the scintillation counter in the above group, measurements of 8,000 to 11,000 gamma roentgens were obtained in the bladder. These dosages approximate the maximum tolerance of normal bladder tissue at this intensity, and, as might be expected, 10 per cent of the patients treated developed bladder sequelae. A very wide range of rectal measurements was obtained with an average of 12,200 gamma roentgens. Measurements on one patient indicated that the rectal mucosa would have received 40,000 gamma roentgens had the radium been left in place for the usual length of time. Of the patients treated with this arrangement, 35 per cent developed rectal complications. Such a high proportion of complications is to be expected since an average of 12,200 gamma roentgens almost doubles the maximum tolerance of the rectal mucosa at this intensity of treatment.

To illustrate the points mentioned above as regards tissue tolerances, we present a patient who died from extraneous causes three weeks after radium therapy. Measurements at the time of radium implant indicated that a maximum of 7,000 gamma roentgens and 6,700 gamma roentgens were delivered to the rectum and bladder, respectively. Microscopic examination of these tissues showed typical irradiation effects, such as cellular edema, lymphocytic infiltration, fibroblastic proliferation and minimal vascular changes (Fig. 4*A* and *B*). The point made is that there was no evidence of irreversible damage and quite possibly this patient would have tolerated the measured dose without difficulty. From Todd's work, the tolerance of the recto-vaginal septum can be estimated to be

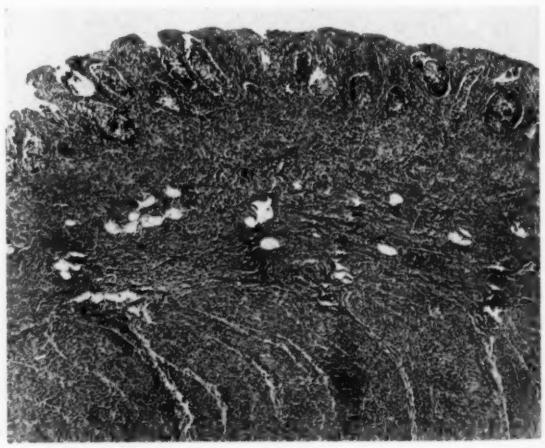

FIG. 4*A*. Low power photomicrograph of rectal wall in area of maximum reaction. Measurements obtained indicated that 7,000 gamma roentgens were delivered to the area within a 120 hour period. No evidence of irreversible necrosis is present.

8,500 to 9,500 gamma roentgens if applied over a period of twenty-one to twenty-eight days. Applications of 12,200 gamma roentgens in a period of thirty hours, as used in the above method, markedly increases the intensity and would be expected to produce untoward sequelae.

The method of treatment in the 1932 to 1936 period is shown in Figure 5. During this time the applications were changed so that each end of the tandem contained 50 mg. of radium. The filtration was 0.2 mm. of platinum, and the treatment consisted of one application for fifty hours, or a total of 5,000 mg. hr. This arrangment delivered 7,000 gamma roentgens at point A, which is within the tolerance level of the

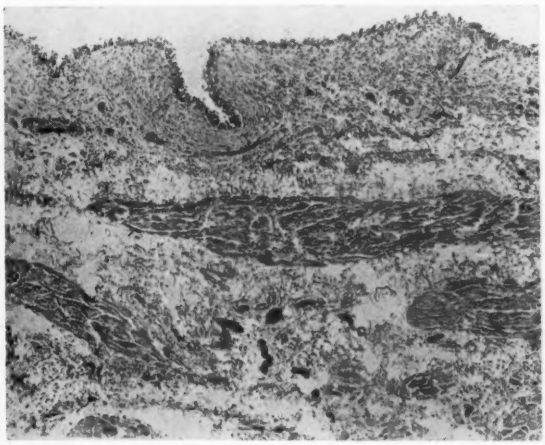

Fig. 4*B*. Low power photomicrograph of bladder wall in area of maximum radiation reaction. Moderate edema is present but marked necrosis is not seen. Measurements obtained at time of radium implant indicated that 6,700 gamma roentgens were delivered in treatment time of 120 hours.

paracervical triangle. Point B received 1,500 gamma roentgens, which represents slight improvement over the former treatment. Dosage determinations in the rectum and bladder with this arrangement have averaged 9,800 gamma roentgens and 8,300 gamma roentgens, respectively, representing a slight decrease from the first method. A decrease of 3 per cent in sequelae was noteworthy.

Vaginal applications of radium were first used in 1937 and have been a routine procedure in all patients treated subsequently (Fig. 6). The strength of the radium sources was reduced to units of approximately

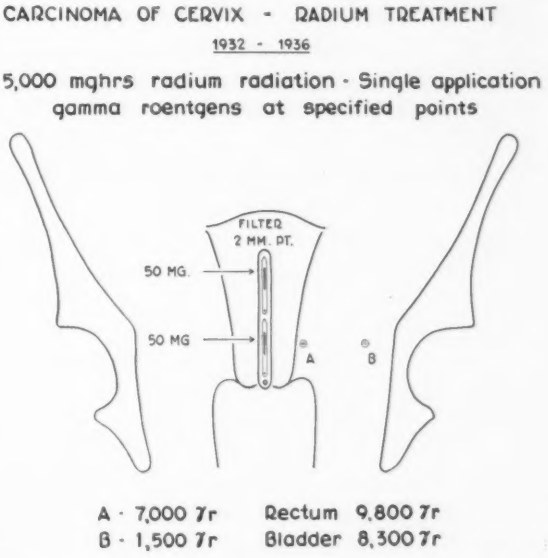

Fig. 5. Method of radium treatment in 1932–1936 period. Entire dosages delivered within a single application of fifty hours.

25 mg. each. Total doses were administered on the order of 4,000 to 5,500 mg. hr. Initially this amount was delivered at one

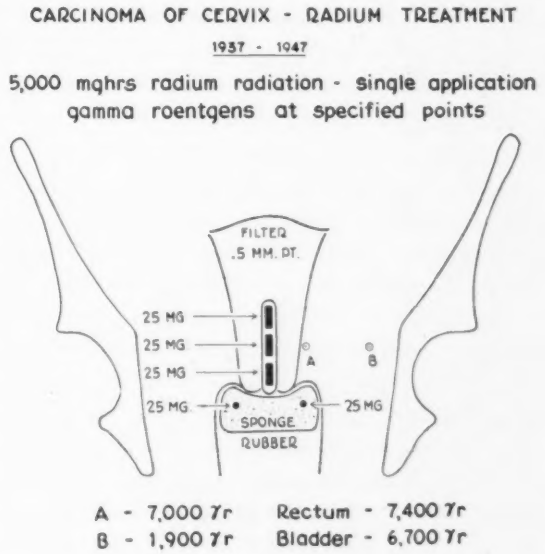

Fig. 6. Method of radium treatment during 1937–1947 period. Measured and calculated dosages delivered within one single application of forty hours or two applications of twenty hours each.

sitting, but in the latter half of the 1937 to 1947 period, the application was made in two approximately equal exposures, about one week apart. The vaginal sources were held in place by means of a piece of sponge rubber, cut to fit the vaginal vault. The sources of 25 mg. of radium were arranged in the sponge rubber so as to place one in each lateral fornix. The distance between

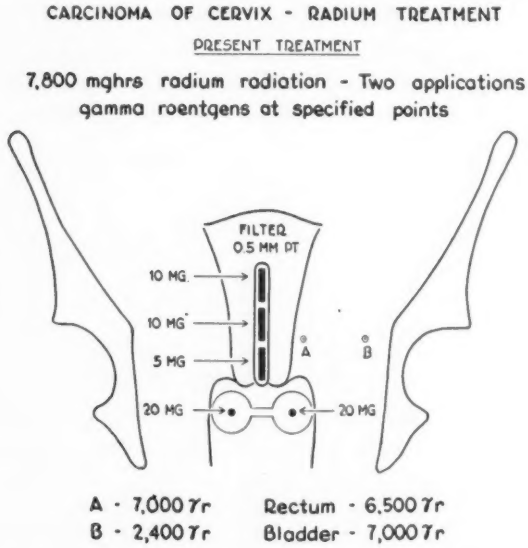

FIG. 7. Present method of radium treatment for carcinoma of the uterine cervix by the Tumor Service of Barnes Hospital. Measured and calculated dosages delivered by two applications. Treatment time 100–120 hours.

the tubes of radium and vaginal mucosa was estimated at 0.5 to 0.7 cm. During the 1937 to 1947 period, the contribution from roentgen rays was increased and most patients received a tumor dose of about 1,500 roentgens from external therapy before radium was applied. In some instances, transvaginal irradiation was used to deliver an additional 3,000 to 5,000 roentgens, applied directly to the cervix by means of a 100 kilovolt machine. Using this arrangement of radium, 5,000 mg. hr. delivered 7,000 gamma roentgens to point A within forty hours. The latter arrangment, therefore, did not alter the dose at point A, but at point B there was an increase of almost 2,000 gamma roentgens. With this improvement in radium therapy and the increased contribution from roentgen rays during this time, more adequately treated parametrium farther laterally was expected. By this technique, the bladder received about 6,700 gamma roentgens and the rectum approximately 7,400 gamma roentgens. These amounts are considerably less than in the previous groups and concomitantly the incidence of complications is half that in the earlier periods.

Some patients have been treated with radium needles. The technique used has closely simulated that described by Waterman, DiLeone and Tracy.[12] Low intensity needles of 1.0 mg. per centimeter of active length have been used. This method of therapy has been confined almost entirely to individuals with marked parametrial or vaginal extension of the disease. With these sources, total dosages ranged from 7,000 to 8,000 mg. hr. The complications encountered in this type of therapy have been no more frequent than with the intracavity methods just described.

Since 1947, even lower intensity sources have been used. Active lengths of radium tubes have been standardized to 1.5 cm. These tubes contain 5, 10, 20 and 40 mg. of radium. The technique simulates that described by the Manchester group.[9] The patients have been treated with at least two separate radium applications occurring one to two weeks apart. Total dosages have ranged from 7,000 to 8,000 mg. hr. In a further attempt to increase dose levels in the lateral margins of the pelvis, the technique of external deep roentgen treatment has been altered. Smaller portals have been utilized in an attempt to confine radiation to the parametria and thus protect the paracervical areas, bladder and rectum. Treatment time has been protracted and point B has been estimated to receive an average of 2,500 tissue roentgens delivered over a period of twenty-five to thirty days. It is, of course, impossible to evaluate this present method in terms of survival statistics or even incidence of complications, but the measurements that have been obtained at point A, point B

and in the rectum and bladder are significant. These values can be seen in Figure 7. The dose reaching point A is again approximately 7,000 gamma roentgens and, although delivered at a lower intensity, should still be lethal for cervical cancer. Point B received approximately 2,400 gamma roentgens and with the contribution from external radiation estimated at 2,500 roentgens, this method should increase the survival rate in Stage II and Stage III lesions. The dose delivered to the rectum and bladder is about 7,000 gamma roentgens, and this reduction should be reflected by concomitant reduction in sequelae.

On reviewing these patients, it became necessary to establish certain minimal symptoms and clinical findings as being essential for confirmation of complications. An attempt has been made to include all patients with any reasonable evidence of radiation reaction. For example, elevation of temperature that necessitated removal of the radium has been taken as evidence of complication. Intractable vomiting, moderate diarrhea, rectal bleeding, urinary distress, or the development of a definite lesion in the rectum, bladder or local region about the cervix, have comprised the remaining criteria for consideration. The term local reaction has been used to connote visible persistent slough within the cervix.

Using these criteria there has been an over-all complication incidence of 39 per cent. For Stage I the incidence is 36 per cent; in Stage II it is 33 per cent; in Stage III, 44 per cent and in Stage IV, 57 per cent.

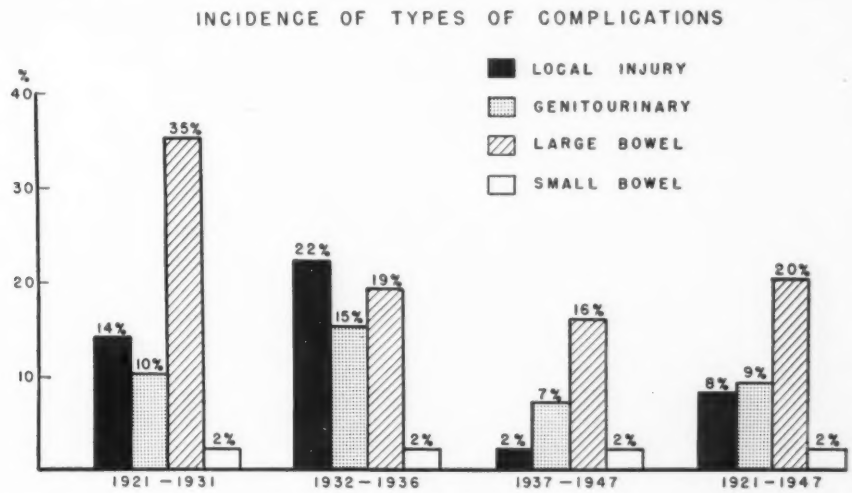

Fig. 8. Incidence of complications in different organs for varied methods of treatment used from 1921 to 1947.

Table II

COMPLICATIONS ENCOUNTERED IN THE THREE TREATMENT PERIODS DURING 1921 TO 1947

League of Nations Classification	1921–1931			1932–1936			1937–1947			Total		
	Patients treated	No. of complications	Per cent	Patients treated	No. of complications	Per cent	Patients treated	No. of complications	Per cent	Patients treated	No. of complications	Per cent
I	7	2	28	15	6	40	52	19	36	74	27	36
II	34	12	35	47	26	55	132	34	25	213	72	33
III	30	25	83	54	31	57	81	18	22	165	74	44
IV	12	10	83	7	7	85	19	6	31	38	22	57
TOTAL	83	49	59	123	70	56	284	77	27	490	195	39

These values are shown in Table II. The incidence of complications in Stage I lesions appears excessive and suggests that many were overtreated.

Figure 8 demonstrates that the most common injury is in the large intestine. Small intestinal reactions, although important, have never been a major problem. The incidence of genitourinary complications occurring in the different treatment periods has ranged from 7 to 15 per cent. During the last ten year period a sharp reduction in local injuries has been evident. The majority of the gastrointestinal and genitourinary complications had their onset four to seven months after treatment. The local reactions to injury appeared entirely within the treatment period or shortly thereafter.

When a patient is first accepted for therapy an attempt is made to classify the lesion as to its clinical stage and morphology. This classification as it pertains to the League of Nations staging of tumors has been a conservative one. The lesions are further classified as infiltrating, fungating, ulcerating or, if no classification can be determined, as unclassified. In correlating the type of lesion with the frequency of complication, it was found that everting lesions were less likely to be accompanied by injury to the rectum and bladder (Table III). Of the infiltrating lesions, 46 per cent became complicated; of the fungating, 27 per cent; of the ulcerating, 42 per cent; and 35 per cent of the unclassified lesions were accompanied by sequelae. This screening effect by everting type lesions has been described previously by Ingelman-Sundberg.[6]

The relationship of infection and complications has been found to be an important one. Infection with its resultant poor vascularity and inability of the normal tissues to withstand the added trauma of irradiation has been accompanied by a significantly higher incidence of sequelae. This reduction of the so-called resistability of the normal tumor bed of the host tissues is reflected in this group of patients. Of the patients with complications, 66 per cent were recorded as infected on their initial visit to the clinic whereas only 18 per cent of the patients with no complications were infected.

TABLE III

CORRELATION OF GROSS MORPHOLOGY OF TUMOR AND INCIDENCE OF COMPLICATIONS IN THE THREE TREATMENT PERIODS

Type of lesion	Total	Number complicated	Per cent complicated	Number uncomplicated	Per cent uncomplicated
Infiltrating	253	118	46	135	54
Fungating	137	37	27	100	73
Ulcerating	64	27	42	37	58
Unclassified	36	13	36	23	63
TOTAL	490	195	39	295	61

The survival rates are 29 per cent, 21 per cent and 35 per cent for the different methods of radium arrangement. The overall five year survival of the entire 1921 to 1947 period was 30 per cent. These statistics are presented in Table IV.

A comparison of the survival rate of the patients with and without complications reveals that in the two earlier treatment periods the survival of the cases with complications is higher than in those without complications. In the last period the survival statistics are essentially the same in both groups. This discrepancy is probably due to inadequacies of treatment by an intrauterine tandem alone. Delivering all the radiation by tandem resulted in high dose effects in the adjacent tissues. The high tolerance of the cervix and uterine

wall permitted recovery in spite of severe damage in many instances. Among the patients with radium injury the zone of tumor control must have been somewhat wider and, as a result, a higher survival rate was obtained. With improved distribution of irradiation in patients treated by intrauterine tandem and vaginal sources, the better survival rate in the complicated group does not apply.

As previously mentioned there has been an increase in percentage incidence of Stage I cases in the 1937 to 1947 group. This, of course, is an important factor in the improvement of average results in the latter treatment period. However, except for Stage IV lesions there has been an advance in survival rate for each stage. This clinical proof of increase in survival rate can be correlated with the calculations at points A and B shown previously and is evidence of extension of the zone of tumor control toward the lateral margins of the pelvis. It is significant that with this improvement the incidence of complications could be decreased to its present level. The incidence of sequelae is, however, still high and it is hoped that newer methods may contribute still more toward tumor control and a lower incidence of accompanying complications.

TABLE IV

SURVIVAL RATES FOR EACH STAGE OF DISEASE IN THE THREE TREATMENT PERIODS FROM 1921 TO 1946

League of Nations Classification	1921–1931			1932–1936			1937–1946*			Total		
	Patients treated	5 year survivals	Per cent	Patients treated	5 year survivals	Per cent	Patients treated	5 year survivals	Per cent	Patients treated	5 year survivals	Per cent
I	7	4	57	15	8	53	42	25	60	64	37	58
II	34	18	53	47	16	34	113	49	43	194	83	43
III	30	2	7	54	3	6	76	11	13	160	16	10
IV	12	0	0	7	0	0	14	0	0	33	0	0
TOTAL	83	24	29	123	27	21	245	85	35	451	136	30

* 39 cases treated in 1947 omitted.

SUMMARY

Complications of treatment as well as survival rates provide the criteria with which a method of therapy must be evaluated. The method of therapy and complications of treatment of 490 patients with cancer of the uterine cervix have been reviewed. Dosage determinations in the rectum and bladder with the various methods of radium arrangement have been made by means of a scintillation counter. Calculations of the dosages reaching points A and B of the Manchester system with the different radium arrangements have been made by means of isodose curves. These dosages have been correlated with the method of treatment, incidence of complications and survival statistics.

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A PHYSICAL APPROACH TO THE DESIGN OF APPLICATORS IN RADIUM THERAPY OF CANCER OF THE CERVIX UTERI*

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UNTIL about fifteen years ago, complete empiricism had prevailed in the treatment of cancer of the cervix uteri with radium. The uterine tandem was originally used alone; later colpostats of various shapes were introduced. The dosages were calculated in terms of milligram hours, and clinical experience alone determined the amount of radium tolerable to the tissues. The T-shaped arrangement of the radium sources is, of course, geometrically logical. However, no attempt to understand the respective contributions of the radium sources has been made.

Interestingly enough, irrespective of the technique used, the results are similar in institutions all over the world where radiotherapy is practiced with care. This shows that the usual T-shaped arrangement of the radium sources permits a satisfactory volume of tissue to be irradiated adequately in a certain percentage of cases. Most of the work so far has been done with calculations[7,8,10,13] based on theoretical geometrical arrangement of radium sources and their relationship with pelvic organs. Applicators were designed accordingly.[8,9] Careful three-dimensional procedures[6] were devised, the rectum and bladder being visualized by opaque media.

Recently, direct dosimeters have been designed to read dosage rates in the bladder and rectum at the time of implantation, and on the pelvic wall while the radium is in situ at the time of a lymphadenectomy.[3,5]

The multiplicity of radium techniques and of applicators shows that the best arrangement of radium sources, the respective loading of the uterine tandem and colpostat, and the best design of the colpostat are still unknown. It also demonstrates our lack of knowledge concerning the respective contributions of the uterine tandem and colpostat to the various points where disease is likely to be present, as well as to the rectum and bladder. The number of milligram hours varies from a total of 5,000 (which is the dosage delivered by a number of techniques still in use) to a total of 12,000 or 13,000 as used in the Manchester system. The average is 7,000 to 8,000 mg. hr. (Paris and Stockholm techniques). The tolerance of the rectum and bladder has been set around 5,000 to 6,000 gamma r (no time factor correction) although no measurements have been made. There are no series reported where rectum and bladder damage has been correlated with figures. Theoretical calculations, assuming average positions and distances, are entirely inaccurate. Within a few centimeters of radium sources, the gradient of dosage rate is so sharp that small changes in distance bring considerable difference in dosage rates.

We are still in an empirical era in the use of radium therapy in cancer of the cervix. A coordinated effort should be made to determine by measured data the tolerance of the vault, rectum, and bladder; the amount of irradiation tolerable to the tissues which will control the greatest number of primary lesions; and the range of doses which would eventually control disease in the pelvic lymph nodes. Uterine tandems and colpostats should be designed (and respectively loaded) depending on the knowledge of the contribution of the

* Presented at the Thirty-fourth Annual Meeting, American Radium Society, Chicago, Ill., June 8–10, 1952.

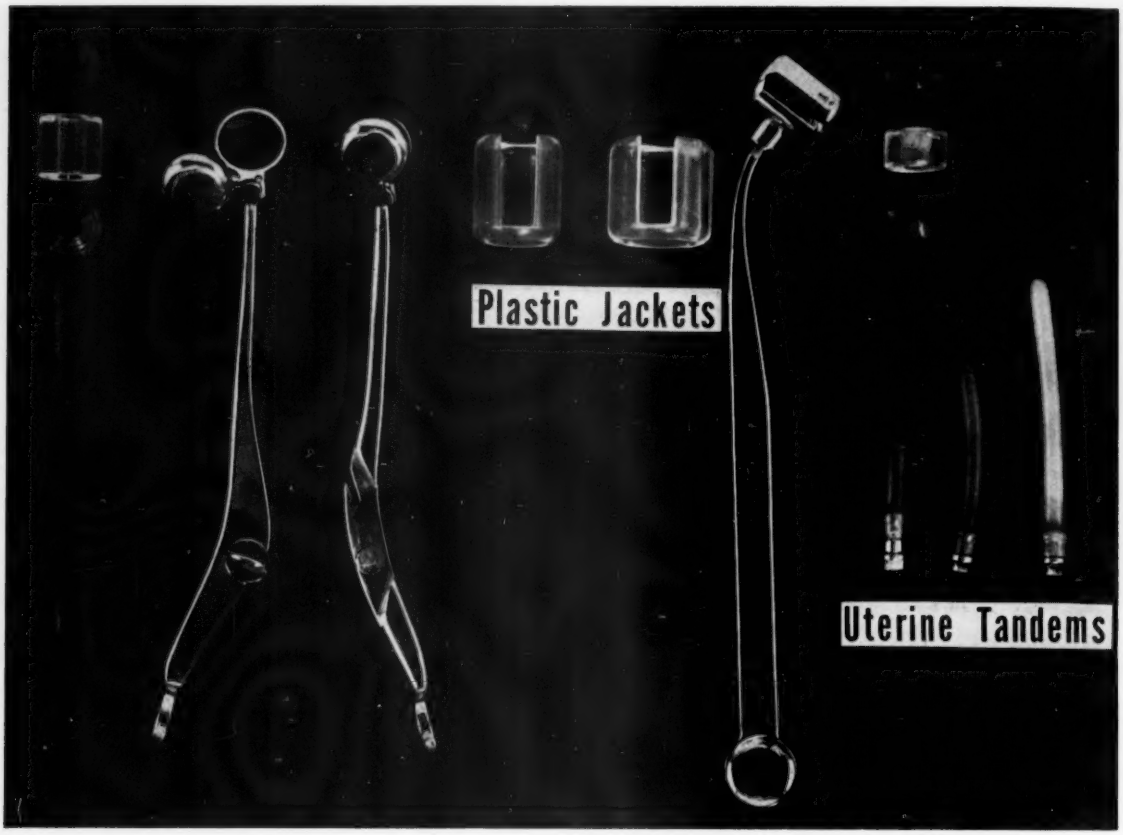


FIG. 1. Photograph of applicators. A pair of cylinders (2 cm. in diameter), with interlocking handles and one single cylinder with a straight handle. Plastic jackets of two thicknesses are added to make medium and large sizes (2.5 and 3 cm. in diameter). The applicators have the same diameter as the Manchester ovoids, but not the shape of an isodose surface. The shell is made of brass (or stainless steel), which gives minimum secondary electron emission. In order to reduce the dosage in the direction of rectum and bladder, tungsten buttons are inserted at each end for the purpose of screening. (They are in their true positions on the drawing in relation to the axis of the ovoids.) They are not uniform discs. (The rectal side button is a half disc and the bladder side button a 150° section.) They are located to provide maximum screening to the anterior rectal wall and trigone of the bladder, without decreasing the radiation in the direction of the uterosacral and broad ligaments. Each ovoid is fastened to a separate handle. These handles are easily locked together. When there is shortening of one fornix, the ovoids can be held in each fornix, but at different levels, by taping instead of locking the handles. The range of separation is from contact to 4 cm. (2 to 6 cm. for the radium sources). The handles have notches to give points of reference for three-dimensional reconstruction. Packing is used only in front of the cervix along the vaginal tube around the handles to hold them as much as possible in a steep position against the anterior vaginal wall. It should be tight to prevent slipping of uterine tandem and rotation of colpostat. The ends of the handles have a round, flat surface which protrudes out of the vulva by a few centimeters. This arrangement is not uncomfortable to the patient, and allows a quick check every day to see if rotation has occurred. If it has, it can easily be corrected.

various radium sources to all important points of the pelvis. The applicator should be flexible enough to be adaptable to the great differences due to individual anatomy, as well as pathological changes. The insertions ought to be multiple so that corrections can be made, if necessary, at the second or third insertion. This helps eliminate the zones of underdosage where disease is clinically present or likely to be. The dosimetry should not only be a check but a guide in the treatment. It requires

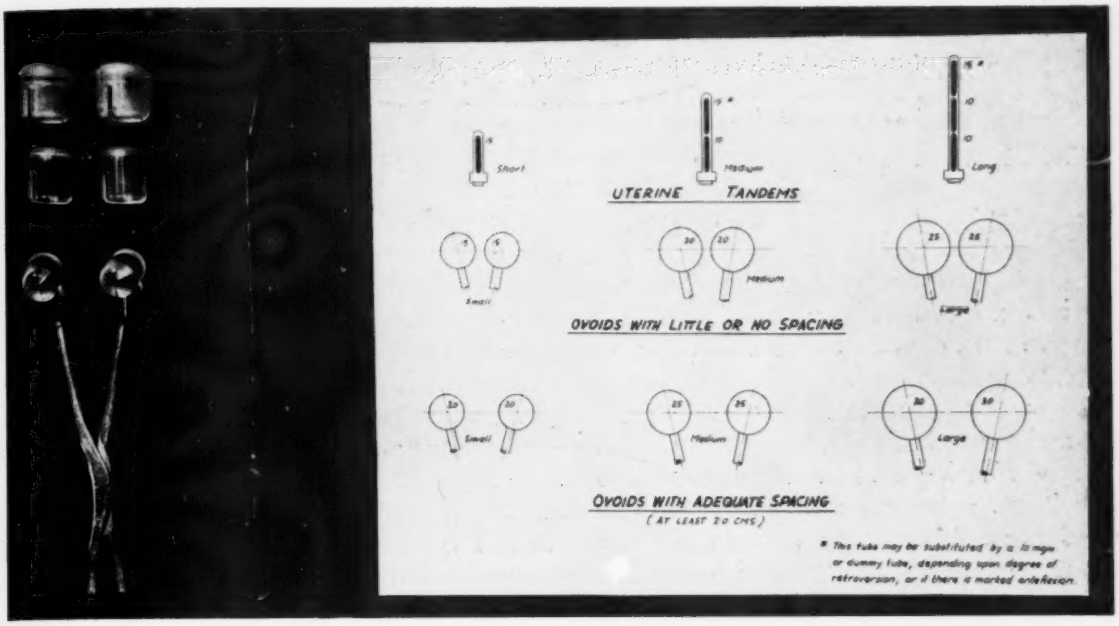


Fig. 2. Treatment of Carcinoma of the Cervix, Loading of Sources.

(1) *Standard Loading for Tandem* (from fundus to cervical canal). Short: 15 mg. Medium: 15-10 mg. Long: 15-10-10 mg. The standard loading will be modified whenever necessary. Reasons for modifications are as follows: (a) Whenever the direct reading with the scintillation counter in the first application is over 3,500 r in the rectum and over 3,750 r in the bladder, providing that the major contribution is coming from the intrauterine tandem (retroversion or marked anteflexion). The modification, in most of the cases will consist of a lower loading of the top tube (10 mg.), or a shorter tandem. If the uterus is in retroversion, a shorter tandem will be used in the second application. (b) If the tumor is infiltrative, very bulky, or if there is an increased distance between ovoids and tandem, the loading in the cervical canal is increased (up to 20 mg.). (c) When the uterus is atrophic or the posterior lip completely destroyed by the lesion, there may be a very short distance between the tandem and the rectum and the loading in the cervical canal will be decreased (to 6 mg. or a dummy).

(2) *Standard Loading for Ovoids.* Small: 15–18 mg. Medium: 20–25 mg. Large: 25–30 mg. The loading of the ovoids will be decided by the following factors: (a) size of ovoids; (b) separation between the ovoids; (c) distance between the tandem and ovoids; (d) doses (direct readings) in the rectum and bladder in the first applications.

(3) *Standard Loading, Tandem and Ovoids.* There are two ways to decrease the dose of the whole system. The modifications are as follows: (a) load with less radium in the tandem as well as the ovoids; (b) change the treatment time.

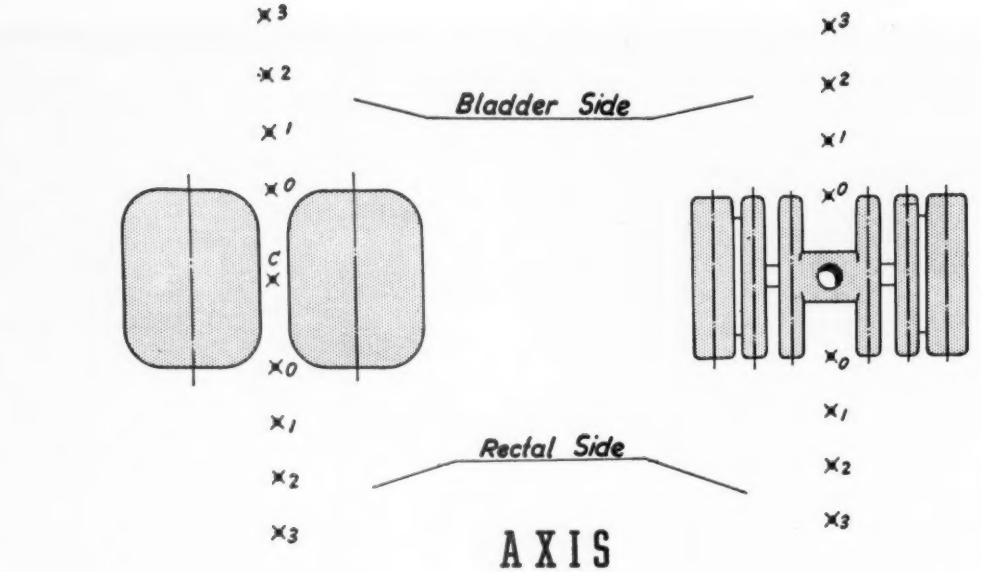
calculations by means of simple dose finders and direct measurements at the time of implanation.

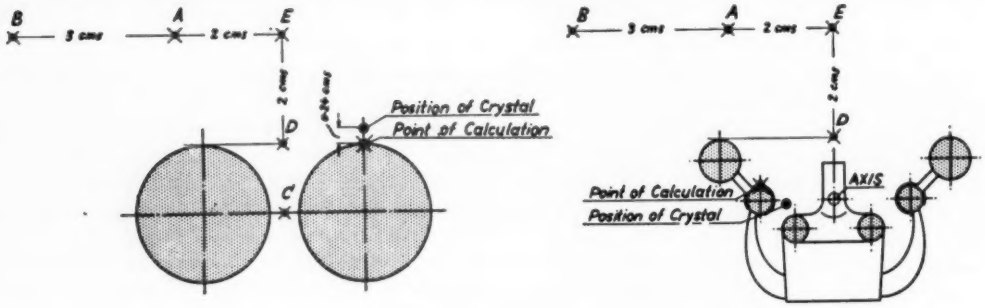
RADIUM TECHNIQUE

In view of the lack of actual knowledge, the radium treatment ought to be based, essentially, on a clinically well tested technique. The Manchester colpostats were chosen because of their great adaptability to the individual cases as well as for their advantage in the physics of radium therapy. This applicator takes advantage of of the size of the vagina to increase the radium-mucous membrane distance. This allows a greater increase in the total number of milligram hours and, therefore, a greater volume of adequate radiation.

A colpostat[1] has been designed (Fig. 1) to provide maximum adaptability to varying anatomy and, by built-in screening and fastening to handles, to eliminate some of the difficulties of application of the Manchester colpostats. Table 1 shows a difference of less than 5 per cent in dosage rate in the equatorial plane between the plastic and metal applicators. The tungsten screening diminishes the dose to the bladder and

TABLE I





EQUATORIAL PLANE

	EQUATORIAL PLANE					AXIS								EQUATORIAL PLANE VAULT
	C	D	E	A	B	BLADDER SIDE 0	1	2	3	RECTAL SIDE 0	1	2	3	
Small Plastic Ovoids 0.5 cm Separation 15 mgs Ra each, 144 hrs	18,800	12,000	2,940	2,480	1,060	5,400	2,150	1,320	920	9,600	4,030	1,900	1,160	11,250 (15,980)
Metal Ovoids 0.5 cm Separation 15 mgs Ra each, 144 hrs	17,600	11,250	2,760	2,340	1,000	4,950	1,770	850	610	6,680	3,080	1,710	950	10,800 (14,980)
Metal Ovoids 1.0 cm Separation 15 mgs Ra each, 144 hrs	12,500	9,000	2,650	2,380	1,010	4,650	1,800	860	620	5,400	2,620	1,490	880	10,010 (14,380)
Metal Ovoids 2.0 cms Separation 15 mgs Ra each, 144 hrs	7,360	5,850	2,280	2,250	1,110	3,730	1,830	940	650	4,300	2,100	1,310	810	9,420 (13,800)
Metal Ovoids 3.0 cms Separation 15 mgs Ra each, 144 hrs	4,800	4,050	1,940	2,110	1,190	3,020	1,730	1,050	690	3,300	1,830	1,160	760	8,870 (13,470)
Metal Ovoids 4.0 cms Separation 15 mgs Ra each, 144 hrs	3,300	2,890	1,650	1,980	1,360	2,330	1,560	1,040	690	2,340	1,590	1,040	690	8,630 (13,310)
Ernst Applicator Fully Open, 100 hrs 6 Ra Sources, 10 mgs ea	11,200 (11,410)	10,900 (10,380)	3,980 (3,495)	3,800 (3,340)	1,520 (1,495)	9,930	4,380	2,510	1,570	9,300	4,500	2,480	1,610	33,240 (43,900)
Ernst Applicator 4 Ra Sources 10 mgs each, 100 hrs			Closed Half Open Fully Open	3,120 2,370 3,130	1,072 1,012 1,072									

1mm Pt Filtration, 1·5 cms Active Length

( ) = Calculated

rectum. In view of the small difference in dosage rate in the equatorial plane between the two types of applicators, no radical departure is now being made from the radium loading formerly used in plastic ovoids (Fig. 2).

The treatment consists of two applications of seventy-two hours each; whenever possible, tandem and ovoids are used together. The interval between applications is eleven days. Dummy plastic ovoids of the same size as the metal applicators are used in the clinic to determine the proper size for each individual patient. Care is taken to see that the dummies fit loosely, so that the metal ovoids will be positioned as high as possible in each fornix (Fig. 4). The length of the uterine cavity is measured with the sound. In order to take advantage of the size of the vagina, radium therapy is given first. However, in large or infected or markedly ulcerating lesions with obliteration of one or two fornices, external irradiation is given first (1,500 to 2,000 r tumor dose) and the radium dosage is reduced accordingly. Modifications are made depending on the clinical variety and stage of the disease. For instance, if the lesion is more infiltrative and if there is no retroversion or extreme anteflexion, the uterine loading is somewhat higher (15, 15, 10 mg.) and the vaginal loading is diminished (15, 20, 25 mg.). Not infrequently one ovoid only is used in contracted or deeply ulcerated vaults. If the disease involves the lower part of the vagina, a combination of plastic ovoids and vaginal cylinders is used in one or all of the insertions.

If the tandem or the ovoids do not fit in the proper position, it is always preferable to modify the application at once. The modification will consist of: (a) changing the size of tandem or ovoid; (b) insertion of either ovoids or tandem alone. When the ovoids and tandem are inserted separately, the applications are repeated three or four times at weekly intervals. Before each application, the patient is measured with dummy applicators, as smaller size cylinders are often used due to shrinking of the vagina. Shorter tandems may also be used.

TECHNIQUE OF APPLICATION

The loaded tandem is inserted and dummy ovoids of the proper size are placed in the vaginal fornices. Direct measurements with the scintillation counter are then taken (Fig. 3). The dummy ovoids are now replaced by the loaded ovoids and readings are taken in the bladder, anterior and posterior fornices, and rectum. Packing is then done. Due to the special construction of the ovoids, providing protection to the

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Table of doses at points seen on the drawing. The Ernst colpostat is used for comparison.

Measurements around the applicators, single and in pairs, were made with a scintillation counter. Assuming that there is no extra packing, the rectum and bladder doses would be represented approximately by the doses at 1 cm. above and below. There is a definite gain in favor of the metal ovoids. The advantage of placing the cylinders in each fornix, as far apart as possible, is seen in the improvement of the dose at point B, and the ratio

$$\frac{\text{Dose at point B}}{\text{Dose at point A}}$$

(Theoretical points A and B, 2 cm. distal to flange and then 2 cm. and 5 cm. perpendicularly. These points have no anatomical significance, point B being very rarely in the vicinity of the obturator nodes.)

The separation decreases the rectal dose, and to a lesser extent the bladder dose, due to the shape of the isodose curves.

The applicators are loaded with 15–20 mg., 20–25 mg., or 25–30 mg. of radium, depending on the separation and diameter of the applicators. The figures of Table 1 should be multiplied by the corresponding coefficient.

This table has been made for comparative purposes. In clinical work a three-dimensional procedure has to be used for determination of dosages at all important points.

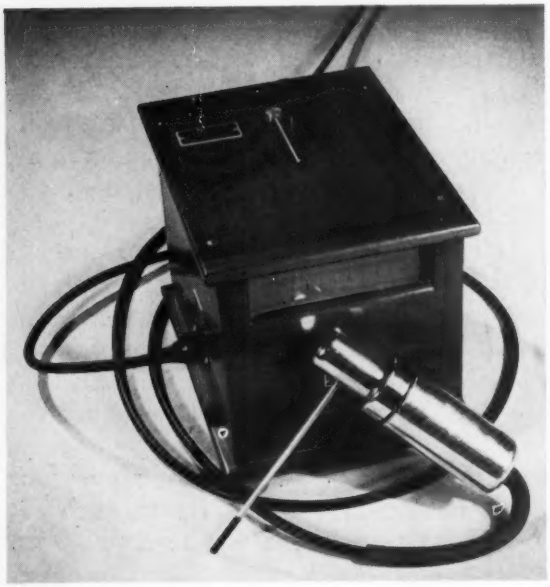


FIG. 3. The clinical probe is a scintillation counter employing an anthracene cylinder 1.5 mm. in diameter by 1.5 mm. in length, as the detecting phosphor. The crystal is located at the distant end of the slender shaft which is 5 mm. in diameter. When subjected to radiation, the crystal emits light which is transmitted to the 931A photomultiplier by a lucite rod. The photomultiplier converts the light to an electrical current which registers on a medium range galvanometer, reading directly in roentgens per hour as a rate meter. The covering shaft of the probe is marked in centimeters so that the readings at various depths of the bladder and rectum can be related to the distance from the opening of the urethra or anus. An anthracene crystal of the above dimension is chosen as the scintillator because its response to scattered radiation is nearly airlike for radium gamma rays and its small size allows a close approach to the sources without appreciable error. The small direct effect of radiation on the photomultiplier tube and the lucite rod is subtracted from the total current reading, yielding just the effect of radiation on the crystal.

bladder and rectum, packing is only used between them and the rectovaginal septum if the readings in the rectum are too high. Packing is used in addition in front of the cervix to prevent slipping of the uterine tandem, and around the handles to prevent rotation of the colpostat. Tight packing also helps displace the whole radium system upward and centrally (Fig. 4 and Table II), decreasing the dose to bladder and rectum and giving a better contribution to the pelvic nodes. Direct readings are again taken in the rectum. Due to the pressure of packing on the urethra, the probe cannot be inserted easily into the bladder. A Foley catheter is introduced in the bladder and the bulb filled with radiopaque fluid to locate the bladder in the roentgenograms. The patient is then sent to the roentgen department, where films are taken. The anterior rectal wall is smeared with barium paste as high as possible.

DOSIMETRY

The dosimetry is done by two complementary methods: (1) direct measurements at the time of implantation; (2) calculation of dosages by a three-dimensional technique.

DIRECT MEASUREMENTS

In order to study the contribution of uterine tandem and colpostat, readings are taken three times:

(1) In the bladder and rectum after insertion of the tandem alone. In order to assure the same position within the pelvis, dummy ovoids (Fig. 2) are then placed and held tight against the fornices to duplicate the pressure of packing. (However, the effect may not be quite equivalent.)

(2) In the bladder, anterior and posterior fornices, and rectum, after placing the loaded ovoids, and before packing.

(3) In the rectum after packing.

A scintillation counter probe, graduated in centimeters (Fig. 3), is inserted in the bladder and rectum. Readings are taken every centimeter. The operator tries to keep the probe against the base of the bladder without pressure; otherwise depression of the mucous membrane brings the probe too close to the radium sources (readings with and without pressure show great differences) (Table II). The readings on the galvanometer increase up to maximum and then decrease. The probe is then withdrawn gently, keeping contact with the bladder wall, and readings are again taken. If the readings on entrance and

withdrawal are close, assurance is given that the tip of the probe has followed the wall. If there is a discrepancy between the two readings, the readings on withdrawal are used, as it is easier to follow the bladder wall without applying pressure on withdrawal of the probe.

For readings in anterior and posterior fornices, the tip of the probe is placed in each respective fornix.

roentgen technicians (Fig. 4). From those films coordinates of points of interest can be read with the help of a ruler and graph. A dose finder (Fig. 5) was built to reconstruct in space (double scale) the axes of the cylinders and the uterine tandem. The tip of a movable rod is then used to locate in space the points of interest, the coordinates of which are obtained in the same manner. Depending on the number of points con-

TABLE II

CASE	INSERTION	DATE	LOAD	MEASURED					CALCULATED WITH DOSE FINDER												REMARKS
				BLADDER		RECTUM		POSTERIOR FORNIX	BLADDER		RECTUM		OBTURATOR NODES		HYPOGASTRIC NODES		POINT "A"		POINT "B"		
				Tandem	Ovoid Tandem	T	O+T	O+T	T	O+T	T	O+T	L	R	L	R	L	R	L	R	
8009	I	3/9/32	25 mg 15 10 25 mm	110 (275)	665 (1650)	1020 (2520)	1760 (4230)														Stage II Gross distortion of posterior lip extending to right. First application only 29 hrs because of unsatisfactory geometry. On second application high dose to rectum due to Tandem. Dose higher for O+T than O alone. Third application with short tandem. 100% and 50% difference between calculated and measured doses to bladder and rectum. Figures in ( ) in first application are for 72 hrs
	II	3/12/32 72 hrs	21 L 15 10 21 L	840	1040	4230	3700														
	III	3/15/32 69 hrs	21 mg 10 21 mm	256	940	680	1510	2040	352	1288	236	1046	678	630	241	234					
TOTAL			9,955 mgh	1206	2645	5930	6960														
8040	I	3/10/32 72 hrs	21 S 21 S		1450		230	2840		1510		1328									Infiltrative Stage III with obliteration of fornices. 2000 r tumor dose Preradium. No third application (Tandem alone) because of rectal dose. 5590 yr = 2000 r
	II	3/15/32 72 hrs	15 10 15 S 10 S		2640		3280	3850	600	1890	2580	3290	840	900	620	710					
TOTAL			7,704 mgh		4090		5590	6690		3400		4618									
7938	I	3/21/32 72 hrs	25 L 15 10 35 L	2280	2760	2280	2610		861	2411	1315	2575	1065	809	764	750	3492	5012	1185	3300	Tandem displaced to left in second application, the readings after insertion of T alone are taken without using dummies. They are much higher than the readings after insertion of the whole radium system. This is explained by the fact that insertion of O+ packing displaces upward the radium sources. This also explains why in the second application doses to bladder + rectum were less for whole radium system despite same loading + separation, probably due to tighter packing
	II	3/24/32 72 hrs	25 L 15 10 25 L	3480	1470	740	1960		510	2410	1200	2720	1070	710	1070	90	4582	3755	1455	1270	
TOTAL			12,960 mgh	5760	4230	3020	4550		1371	4821	2515	5295	2135	1519	1834	840	8074	8767	2640	4570	
7919	I	3/25/32 72 hrs	18 S 18 S		540		1280														Stage I. Cervix three times normal size. Readings were taken deliberately with and without pressure on the bladder, and were seen to vary depending on the pressure, e.g. at 8 cms from the urethral orifice, 1760 r without pressure, 3640 r with pressure
	II	3/31/32 72 hrs	15 10 10	980	980	840	840														
	III	4/3/32 72 hrs	21 M 15 10 21 M	1460	2490	1170	3070														
TOTAL			10,656 mgh	2440	3710	2010	5190														
8271	I	3/7/32 72 hrs	25 L 15 10 20 25 L	2520	3270	1010	2720	3070	860	1820	820	2790	1090	1810	1170	890	4190	3770	1350	940	Three months pregnancy. Stage I. Great difference in rectal dose in each application, although little change in loading. Lack of agreement between measured and calculated doses. Rectal dose much greater in second insertion despite small difference in loading
	II	3/14/32 72 hrs	30 L 10 10 30 L	2940	3920	1950	4950	4370	1200	2600	1070	3550	1420	1690	830	1070	3820	4100	1440	1450	
TOTAL			12,600 mgh	5460	7190	2960	7870	7440	2060	3920	1890	6290	2510	3500	2000	1960	8010	7870	2860	2390	
8269	I	3/17/32 72 hrs	21 M 21 M		1390 (7 cms)		1890 (6 cms)	3880													Points of maximum dosage are different for ovoid alone and tandem alone. On the fourth application, readings were taken without packing and a dose of 3290 r was found. With packing, the point of maximum dose was displaced 1 cm upwards, and the dose reduced to 2980 r. Note the differences between the third and the fourth insertions where the same tandem with the same loading was used. Figures in [ ] in third and fourth insertion are for 72 hrs
	II	3/20/32 72 hrs	20 M 20 M		887 (7 cms)		1700 (4 cms)	2290													
	III	3/25/32 29 hrs	15 10	150 (10 cms) (387)	150	1320 (8 cms) (4470)	1820														
	III	4/1/32 68 hrs	15 10			1950 (8 cms) (2330)	1950														
TOTAL			7,804 mgh			3770	7350														

The readings in rectum and bladder are done in the same way as those in the bladder, skirting the anterior rectal wall and avoiding pressure.

CALCULATIONS

La Touche and Spiers'[4] three-dimensional reconstruction technique was chosen to calculate doses at significant points because of its simplicity and adequate accuracy for clinical work. The films can be taken on a routine basis on any equipment by

sidered, it takes from one and one-half to two hours to study a case.

The points chosen are:

(1) Base of bladder, determined by sodium iodide injected in the bulb of the Foley catheter. From the lateral film one chooses a point which is likely to be the point of maximum dose by its relationship to uterine tandem and ovoids (Fig. 4).

(2) In the rectum, the likely point of maximum dose is determined in the following way: When the films are taken, a small

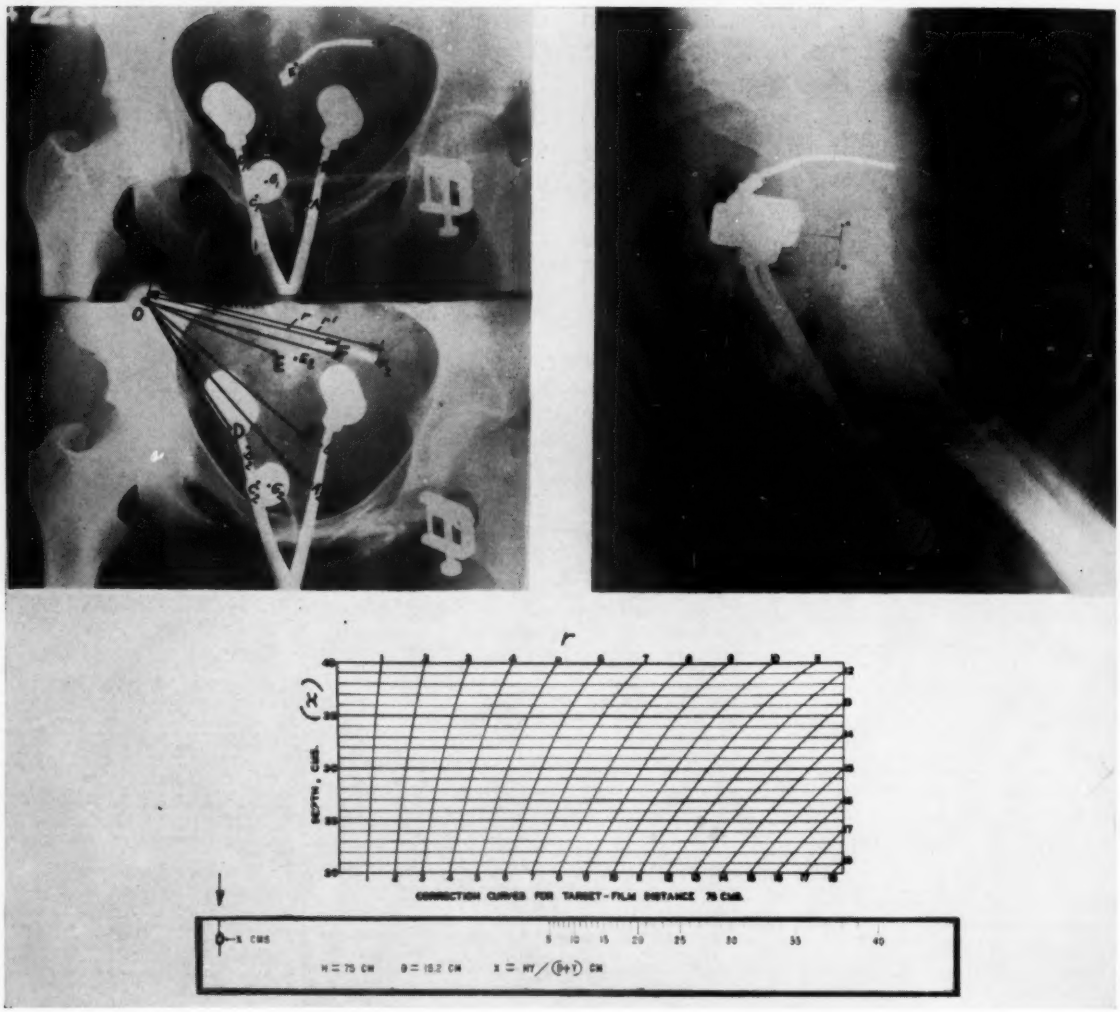


FIG. 4 (Case 8271 of Table II). The colpostats are correctly located in each fornix and the whole radium system displaced upward and centrally. This is well demonstrated by the relationships of the cylinders to the bulb of the Foley catheter (usually just above the vaginal sources) and the acetabulum cavities. This increases the dose to the pelvic wall not only laterally (close to anatomical point B representative of "obturator nodes" group, located 1 cm. medially on the inner surface of the acetabulum), but higher and posteriorly due to a more central location of radium sources. It also decreases rectum and bladder doses (see Tables I and II). Bladder and rectum points are identified on the lateral film.

A modification of the shift technique developed by Spiers is used to reconstruct an implant in relation to the bony anatomy.

The Film. The film is centered to the central ray which is marked by a spot of lead in the center of a plastic block that fits in the cone holder of the tube. The distance from the target to the film is fixed at 75 cm. With the right half of the film covered by a lead mat, the first exposure is made. The tube and the film are shifted 15 cm. to the left, and with the lead mat covering the left half of the film, a second exposure is made.

The Reconstruction. The shift of the tube and the film is equivalent to leaving the tube and film fixed and moving the patient 15 cm. between exposures.

Consider a plane including the central ray and parallel to the movement;

let h = Target-film distance = 75 cm.
d = Shift distance = 15 cm.
P_1 = A point to be reconstructed that lies in the same plane as defined above.
P_2 = The same point in the second exposure.
x = Distance from point P_1 to the film.
y = Parallax.
I_1 = Image of the point in the first exposure.

I_2 = Image of the point in the second exposure.
O = The mark of the central ray on the film.

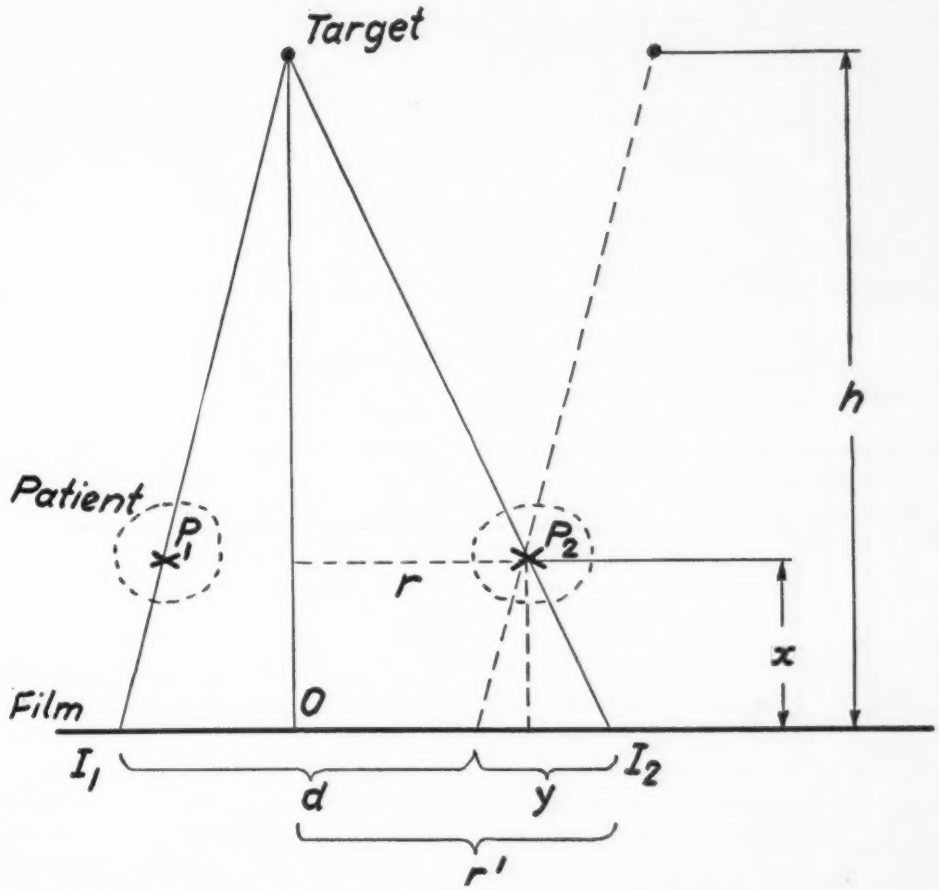
$$\frac{x}{y}=\frac{h}{d+y}$$

$$x=\frac{yh}{d+y} \tag{1}$$

let r^1 = The distance on the film between I_2 and the central ray
r = The distance from the central ray to P_2

$$\frac{r}{r^1}=\frac{h-x}{h}$$

$$r=r^1\left(1-\frac{x}{h}\right) \tag{2}$$



The point chosen for explanation is a special case, but a general point not in the plane defined by the central ray and the movement can be treated in a similar way by utilizing the projections on the plane.

The Use of Special Scales. Equations (1) and (2) can be solved algebraically or by means of special scales. Let us take, for instance, point F, the tip of the uterine tandem. For equation (1), the solution x is plotted on a one-dimensional ruler. The ruler is placed on the film with origin at F_1, and the figure read at F_2 gives the height x.

For equation (2), a transparent sheet of plastic is used. The horizontal axis is r^1, the vertical is x, and the solution r is plotted as a family of curves on these axes. The proper x, determined above, is placed at O and the r^1 axis is laid parallel to the line OF_2. The value of r is read at the point F_2, from the family of curves. The point F is now located in three dimensions—its position in the horizontal plane is determined by the distance r from O in the direction of OF_2; the height is x above the film.

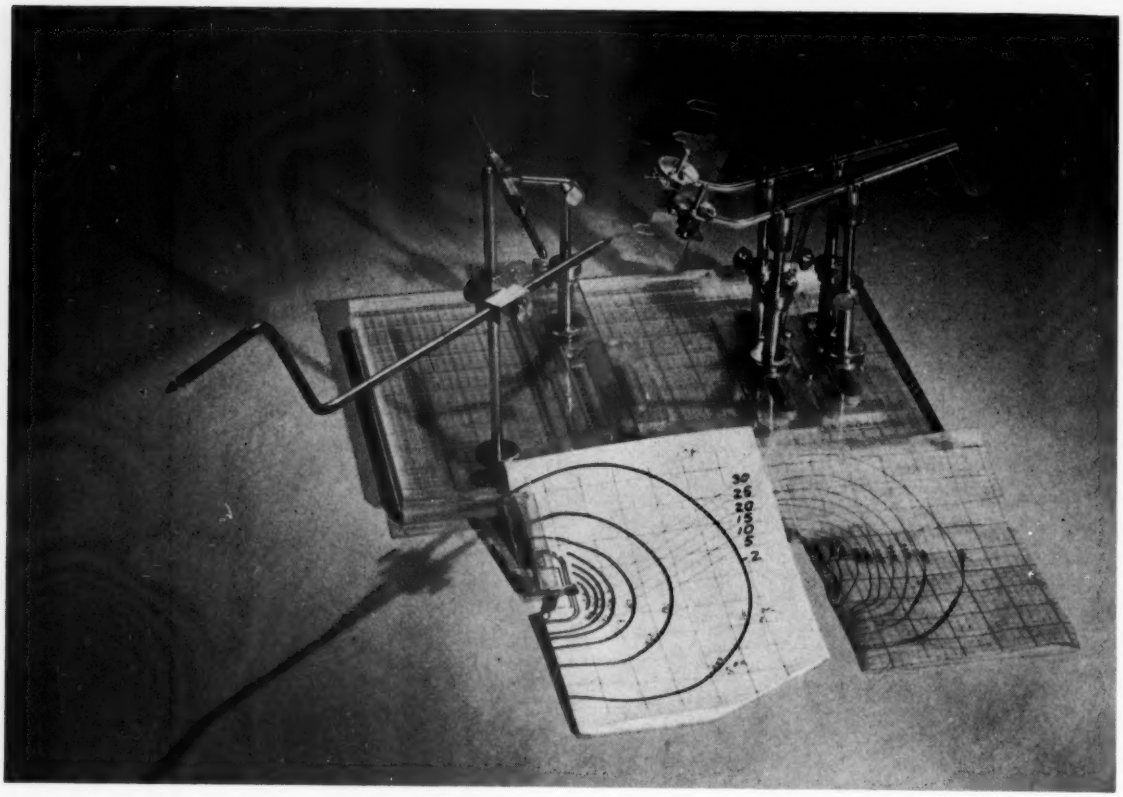


FIG. 5. By the method previously described, the essential points can be set on an adjustable dose finder (double scale for easier handling and fewer errors). When the implant is so reconstructed, the tip of a movable rod is used to locate in space important anatomical points, the coordinates of which can be obtained in the same manner (point A and B, base of bladder, anterior rectal wall, approximate location of groups of nodes on the pelvic wall). The respective isodose curves fastened to a hinge are placed on the pivots representing either the axes of the cylinders or the cervical end of the uterine tandem. They are turned until in contact with the tip of the rod and the dosage rate is read off. The curves for the cylinders are folded along the axis and one reads on one side or the other, depending on whether or not the point is screened by the tungsten buttons. This is determined by drawing the position of the buttons on the disc at the bottom of the pivots.

ring is taped to the anal margin. One draws a line from the ring to a point 0.5 cm. posteriorly to the bottom of the cylinders. One marks on it the distance of maximum dose obtained from the direct readings, taking magnification into account (Fig. 4).

(3) The posterior fornix is located 1 cm. distally from the flange of the tandem and then posteriorly by the thickness of the posterior lip of the cervix, determined by the operator at the time of implantation.

(4) Points A and B are 2 cm. distal to the flange of the tandem and then respectively 2 and 5 cm. perpendicular to the tandem.

(5) The obturator nodes (or "principal gland") region is 5 cm. from the midline on a line joining the centers of the acetabulum cavities. The position of this line in relationship to the radium system is estimated from the lateral view.

(6) The hypogastric nodes region is located 4 cm. straight back of the obturator nodes region. A study of the respective distances of the pelvic wall nodes shows that it is an average distance.

The determination of the contribution from uterine tandem and each ovoid is then made (Fig. 5). The results are tabulated (Table II) with the direct measurements.

The data for evaluation of the implan-

tation are then available: Anteroposterior and lateral film, three-dimensional reconstruction of radium sources, direct measurements in bladder, rectum, anterior and posterior fornices, calculations for point representatives of same anatomical sites and, in addition, points A, B, and point representatives of "obturator and hypogastric nodes." The readings in bladder and rectum are disturbing, as in a number of instances the total doses for all applications (144 hours for the uterine tandem and ovoids) exceed 6,000 gamma r. As our past experience has shown that the same technique has been tolerated without undue complications, we decided to set our maximum doses higher: 7,500 gamma r to bladder, and 7,000 gamma r to rectum; if external irradiation has been given to the midline, 7,000 r and 6,500 r to the bladder and rectum respectively (added r and gamma r).

If the films show an unsatisfactory position of radium sources, or if the rectal or bladder doses are too high for seventy-two hours, the radium is either removed immediately or left less than seventy-two hours.

The loading of uterine tandem and ovoids is modified for the subsequent implantations according to the contribution of the various sources. For instance, in cases where the tandem delivers too high a dose to bladder and rectum, either sources of less intensity or a shorter tandem are used (Table II).

DISCUSSION

Up to the present 40 cases have had direct measurements and 30 cases both measurements and calculations. It has taken several months to put both methods on a reliable routine basis. The measurements have been found to be of definite help in the guidance of the treatment (Table II), particularly in detecting high doses to rectum and bladder, and determining which radium sources were responsible. The loading and size of the applicators are changed accordingly in subsequent treatments. When doses are within the accepted tolerance limits, one has a feeling of safety.

Many more cases will have to be studied and followed up before conclusions can be drawn on tolerance levels and value of the technique. However, some points are already evident:

(1) All data obtained, even with direct measurements or careful three-dimensional reconstruction, are only approximate because of the steep gradient of intensity in the vicinity of radium sources (less than 5 cm.). A slight difference in pressure on base of bladder or anterior rectal wall brings appreciable difference (Table II). In addition, even with tight packing, there is probably some displacement of the applicators during the application. The three-dimensional reconstructions show considerable difference in doses depending on the choice of bladder and rectal points and also differences with measured values.

(2) Tables based on calculations of dosages for theoretical geometrical arrangements of radium sources to arbitrary points A and B, and to rectum, bladder, and pelvic nodes, are meaningless and, more so, even misleading. Varying anatomy and distortion due to disease produce differences in distance which preclude the establishment of tables of dosages for the complete radium system. The same radium system in the two insertions can give great difference in dosages (Table II).

(3) For one-piece applicators the doses at points A and B are accurate but for separate tandem and colpostats a three-dimensional technique is necessary, because of the varying degree of flexion and, at times, lateral displacement of the uterus. The dose at point A is just the dose at some point in the paracervical triangle. The dose at point B is an index of the lateral throw-off but is only exceptionally representative of obturator node group (Fig. 6).

(4) With our applicators the tandem contributes most to the bladder dose. In case of marked anteflexion it can be very high. This confirms the findings of Lederman[5] and Kottmeier,[3] showing that this is

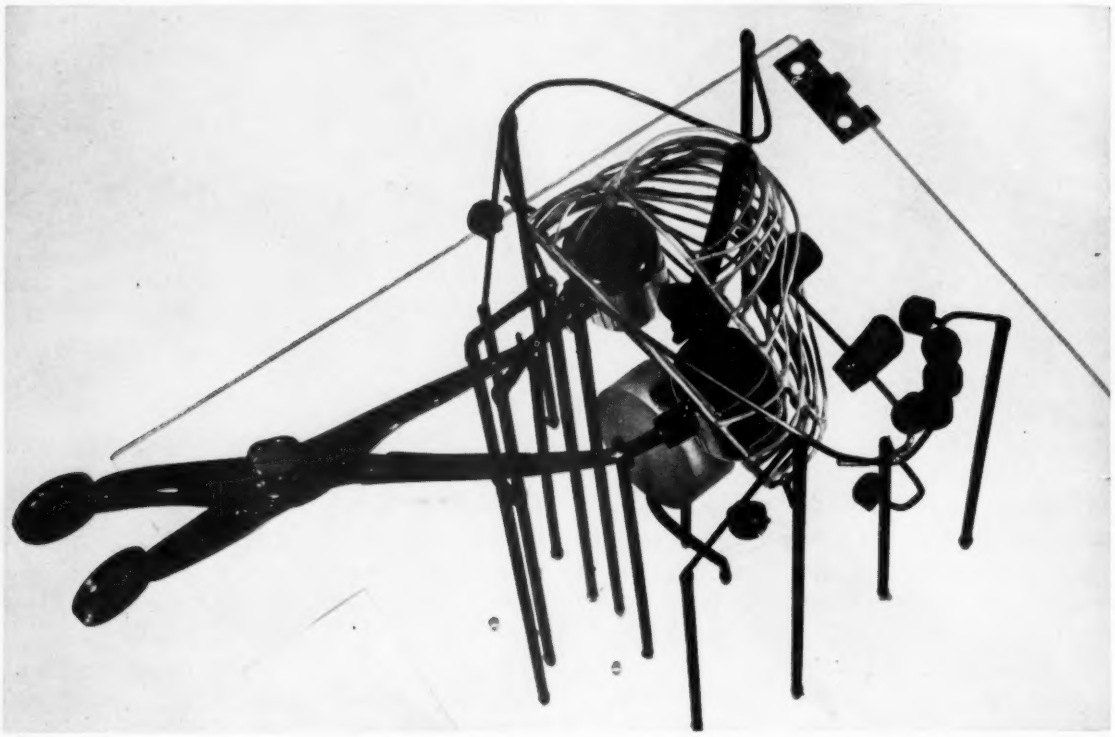


FIG. 6. Three-dimensional reconstruction, using the technique described. The radium implant was actually reconstructed and the cylinders and uterine tandem loaded. The whole system (15–10 mg. in tandem, 30-30 mg. in large cylinders) was then actually measured with the automatic isodose curve recorder. The inner surface represents 7,000 gamma roentgens (144 hours), the outer 5,000 gamma roentgens. Measurements were also made at various points on the pelvic wall. The rectum is represented by the disc of plastic and the pelvic brim by the curved wire. Also shown are points A and B (2 cm. from flange of uterine tandem, then 2 and 5 cm. perpendicularly) and various groups of nodes, obturator (in front), hypogastric (low and back), external iliac (on pelvic brim). One sees that the position of points A and B varies with the degree of flexion of the uterus so that doses cannot be obtained without a three-dimensional technique. One also sees that point B cannot be identified with any group of nodes.

true irrespective of the type of colpostats. The contribution of our colpostats to the rectum has, by and large, been low so that packing between colpostats and rectovaginal septum has not often been necessary. In retroverted uteri or in senile, atrophic uteri, because of the proximity of the tandem to the rectum, doses have been excessive. Our findings here differ from those of the mentioned authors who found that their colpostat contributed mostly to the rectal dose. This is easy to understand in view of the design of their colpostats. The difference in findings shows that conclusions for one technique cannot be applied to another.

(5) With our technique, the posterior fornix could possibly be underdosed, so that measurements are taken at that site.

(6) It has already been found[5] that packing displaces the radium sources upward and centrally so that the bladder and rectal doses will vary with the packing. We have also found, in several instances, that the doses to rectum and bladder were less with the whole radium system than with the tandem alone (Table II). However, our applicators with handles are responsible for most of the displacement.

(7) The tolerance of the bladder and rectum is a function of the size of the area of high dosage. Readings taken every centimeter at the time of insertion of the probe give an idea of the actual dimensions of the area of high dosage.

(8) For ovoids alone, the maximum rec-

tal point is 5–6 cm. from the anus and for the complete system 7–9 cm.

(9) One will be able to correlate complications with the measured figures and so establish tolerance doses on an experimental basis.

(10) While lymphadenectomies are performed, direct measurements, being more reliable, ought to be taken with the radium still in situ at the end of application time.

CONCLUSIONS

(1) Direct measurements in bladder and rectum with the scintillation counter probe, performed at the time of the radium implantation, have already proved to be of definite practical use in the guidance of the treatment.

(2) The doses delivered to the rectum and bladder are, in certain instances, as high as 7,500 gamma r for the bladder and 7,000 gamma r for the rectum. Follow-up of those cases will show if complications will develop and, if so, one would be able to establish tolerance levels by correlating them with measured data.

(3) The usefulness of a three-dimensional technique in determining dosages to points of interest is investigated.

(4) Tables of predetermined dosages for the whole radium system are meaningless.

(5) Colpostats with built-in screening and fastened to separate handles not only make the application safer but displace the radium system upwardly and centrally. This results in smaller doses to rectum and bladder and increased dosage to broad ligaments and pelvic nodes.

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DISCUSSION

Dr. Edwin C. Ernst, St. Louis, Missouri. This paper by Dr. Fletcher and his co-workers is a very excellent radium dosage measurement contribution to the treatment of carcinoma of the cervix.

During the past few days other authors have likewise emphasized the clinical importance of giving initial consideration to both the unusual anatomic and pathologic displacements of the uterus and vaginal vault deformities in relation to the respective positions of the bladder and rectum.

When the primary cancer lesion is presumably localized at the cervical os, the application of radium is a relatively simple procedure and the survival rate is high. However, when con-

fronted with the more advanced group of cervical extensions of the disease, or when parametrial invasion is suspected even in early cases, we must plan to select in advance the most effective positions of the radium sources and total safety dose in order to obtain the necessary uniform concentration of the lethal roentgen-ray and radium intensities within the mid horizontal corridor or equatorial regions of the pelvis between the bladder and rectum. Otherwise, failure to improve our survival rates will be the unfortunate end results—due either to inadequate radium dosage or to the unequal distribution of excessive radiation intensities directly producing localized "hot spots" or delayed injury changes of the normal structures and vital organs of the pelvis. Therefore, each case requires individualized planning as recommended by the essayists.

You may find it necessary to limit the number of radium capsules when irradiating a narrow pelvis vault, but the relative positions of the reduced individual radium sources in relation to the lesions must remain constant.

At this phase of our planning we beg to differ with the authors in that we prefer to employ a single-unit radium applicator which is centered within the cervical canal and, most important, it should be securely attached to six multiple radium sources which can be expanded toward the distal parametrial fields of the pelvis within the vaginal vault. For example, when we first began to routinely check the position of the applied loose radium sources by means of anteroposterior and lateral roentgen examinations of the pelvis, we were surprised at the variable positions assumed by these wandering capsules. Both the individual and semi-loose sources of radiation not only changed positions from patient to patient, but also from application to application in the same patient. Occasionally one of the loose capsules would be found lying directly upon the rectal wall. Under these unreliable conditions of employing loose capsules, or when the uterine canal and vaginal sources are introduced as separate units, I must agree with Dr. Fletcher and his co-workers that the indirect three-dimensional mathematical calculation procedure and the direct scintillation gamma roentgen counter measurement methods in relation to the radiation received along the bladder and rectal walls are both sound added precautionary measures, even though in inexperienced hands they may be subject to error.

However, on the basis of four or more years of actual clinical experience during which period we have observed relatively few instances of severe postirradiation irritation or damage to the vital organs when the lateral roentgenograms of the pelvis clearly indicated that the position of the single-unit applicator's radium sources are not more than 2 cm. from the rectal and bladder walls, the direct rectal and bladder gamma roentgen intensity measurements in our routine therapy procedures have added little to our safety considerations.

Unfortunately, when loose or semi-loose radium sources are employed, the *individual* capsules will of necessity conform to the uterine body and cervical os displacements and vaginal vault deformities, with the result that the position and spacing of the capsules may show wide variations and the uniform isodose distribution of the radium sources is compromised. In reality, these deformities to a large extent should and can be corrected, except in many of the advanced Stage IV cases when only portions of a single-unit radium applicator are applied.

Several years ago we began experimenting with a single-unit type of applicator employing two large expanding Manchester type vaginal ovoids securely attached to the linear radium sources within the cervical canal, and found this procedure somewhat cumbersome and limited to selected cases. Recently, Drs. Sherman, Arneson and Ter-Pogossian employed a similar double ovoid vaginal capsule, but differing from the ovoid method of radium application presented today in that their metal capsules are anchored to the cervical stem.

We have always maintained that it is desirable to protect the respective ends of the vertical vaginal capsules with added filtration or heavy metal protection and note that this added safeguard has also been incorporated in the present Manchester ovoids employed by Dr. Fletcher. Recently a new set of isodose charts was completed by Dr. Ter-Pogossian of Washington University and the gamma roentgen measurements were made with an originally designed scintillating counter. I presume this counter is similar to the one shown by Dr. Fletcher. When the applicator was fully loaded with three 10 milligram radium needles placed in the uterine stem and six 10 milligram capsules of radium in the vaginal vault, the rectal measurements varied between 40 and 49 gamma roentgens per hour. The "A"/"B" gamma roentgens ratio of 29 per hour at B and 73 per

hour at A gives us reasonably accurate information as to the quality and distribution of the radiation intensities toward the parametrial regions of the pelvis. Improved A/B point ratios were obtained, less at A and the same at B, when the proximal 10 milligram needle was removed and added to the distal linear radium capsule (total 20 mg.) in the fundus field of the applicator with a corresponding slight decrease in the rectal dose.

We have evaluated most of the standard methods of radiation therapy of cancer of the cervix on the basis of nine essential criteria: namely, flexibility of the method, simplicity of the application, degree of accurate fixation of the radium sources, uniformity of the radium distribution, correction of uterine deformities and displacements, protection to the bladder and rectum, protection to the operator, reliability of the gamma roentgen dose measurements and, last but not least, the extent and practicability of duplicating the radium dose. Percentages were allotted to each essential criteria on points. Therefore, on the basis of these evaluations, I ventured the statement at the recent 1950 International Congress of Radiology held in London, that when this Congress again convenes in Copenhagen in 1953, the general use of loose capsules, with few exceptions, will be considered to be a relatively obsolete procedure in the radiation treatment of the moderately advanced Stage II and Stage III cases of cancer of the cervix.

In closing, I wish to congratulate the authors for at least in part agreeing with this postulate, and for their efforts to improve the radiation therapy procedures of cancer of the cervix.

Dr. A. N. Arneson, St. Louis, Missouri. Dr. Fletcher's paper has to be read and studied to appreciate it fully. We have had the opportunity to use his applicator and find it both efficient and practical. It enjoys an unusually wide adaptation. The relationship between vaginal and intrauterine sources is improved over that usually obtained. Emphasis should be placed on his meticulous care in measuring doses falling in the region of the bladder and rectum. His observations made in relation to pushing the irradiating sources up into the pelvis are extremely interesting. His major contribution is demonstration of the value of meticulous care which will surely result in an increase in survivals with a decrease in complications.

NON-UNIFORM FILTER TO PRODUCE A FLAT ISODOSE SURFACE OF ROENTGEN-RAY INTENSITY*

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THERAPY type roentgen-ray machines are ordinarily used with copper and aluminum filters. The primary purpose of filtration is to increase the half-value layer and thus obtain adequate depth dose. For those applications involving small fields at focus-object distance values that are not too small, the intensity of the roentgen-ray beam is sufficiently uniform through a cross section. However, there are many occasions when a large field is required. This is particularly true for animal irradiation work then one wishes to irradiate a number of animals at one time. In such cases one is faced with the practical difficulty that the inverse square law and other effects insure a smaller beam intensity at the periphery than in the center of the field; *e.g.*, consider the case for 250 kv. (peak), 15 ma., 0.5 mm. Cu, 1.0 mm. Al, half-value layer 1.48 mm. Cu, 100 cm. focus-object distance; if the intensity of the beam at the center is 100 r, the intensity 50 cm. from the center in a direction perpendicular to the beam is approximately 65 per cent. Fields of this size are commonly used in animal irradiation experiments. It is possible to achieve a relatively uniform roentgen-ray intensity in a plane by the use of filters of non-uniform thickness; *i.e.*, if the thickness of the filter is greater at the center than at the edge, it may be possible to compensate for the greater intensity at the center. At the University of Rochester Medical School, Rochester, New York, such non-uniform filters were built of cast aluminum. There was some practical difficulty due to the occasional presence of air bubbles. An attempt to compute[2] the proper variation of the thickness theoretically has been made with some success. However, this computation depends on estimating the "correct" absorption coefficient for an equivalent monochromatic beam of roentgen rays passing through the filter material.

A number of British workers[3,5] have constructed various types of non-uniform filters for the purpose of attaining a flat isodose curve. One of these methods[5] required the building of an "experimental filter" first, and then an additional filter, corrected in terms of the "experimental filter." Both techniques also require machining of the parts.

Recently, graphite and copper filters[1,4] have been built for producing flat isodose surfaces for the radiation from 22 mev. betatrons. However, the authors do not give any specifications for the construction of these filters.

The problem can be stated analytically as follows:

Let $f(\lambda)d\lambda$ be the intensity of roentgen rays in the wavelength interval λ, $\lambda+d\lambda$. The filter thickness corresponding to the angle α is $t(\alpha)$; t_0 is the thickness at the center. $\mu(\lambda)$ is the total absorption coefficient in the filter for roentgen rays of wavelength λ (see Fig. 1).

The relative intensity transmitted through the central portion of the filter and measured in the plane of the table is given by:

$$1) \qquad I_0 = \int_{\lambda_0}^{\infty} f(\lambda) e^{-\mu(\lambda) t_0} d\lambda.$$

The corresponding intensity in the plane

* This paper is based on work performed under Contract No. AT-04-1-GEN-12 between the Atomic Energy Commission and the University of California at Los Angeles.

of the table in a direction α from the vertical is given by:

$$(2) \quad I(\alpha) = \int_{\lambda_0}^{\infty} f(\lambda)(\cos^2 \alpha) e^{-\mu(\lambda) t(\alpha) \sec \alpha} d\lambda.$$

The problem is to determine the function $t(\alpha)$ so that $I(\alpha) = I_0$ for all values α up to some maximum value α_m defined by the geometric constraints of the roentgen tube. It is evident that an analytic solution for $t(\alpha)$ would be quite difficult even if the function $f(\lambda)$ were well known.

defined by $r_0 = X_0 d/h$, where d is the focus-object distance; h is the distance from the focal spot to the filter and r_0 is the radius corresponding to the largest roentgen-ray field available. It is advisable to use four thimble chambers simultaneously at the same distance from the center and at 90° intervals. In this way azimuthal asymmetry will be checked.

The thimble chambers are then moved radially toward the center some small predetermined distance, *e.g.*, 2.0 cm., and

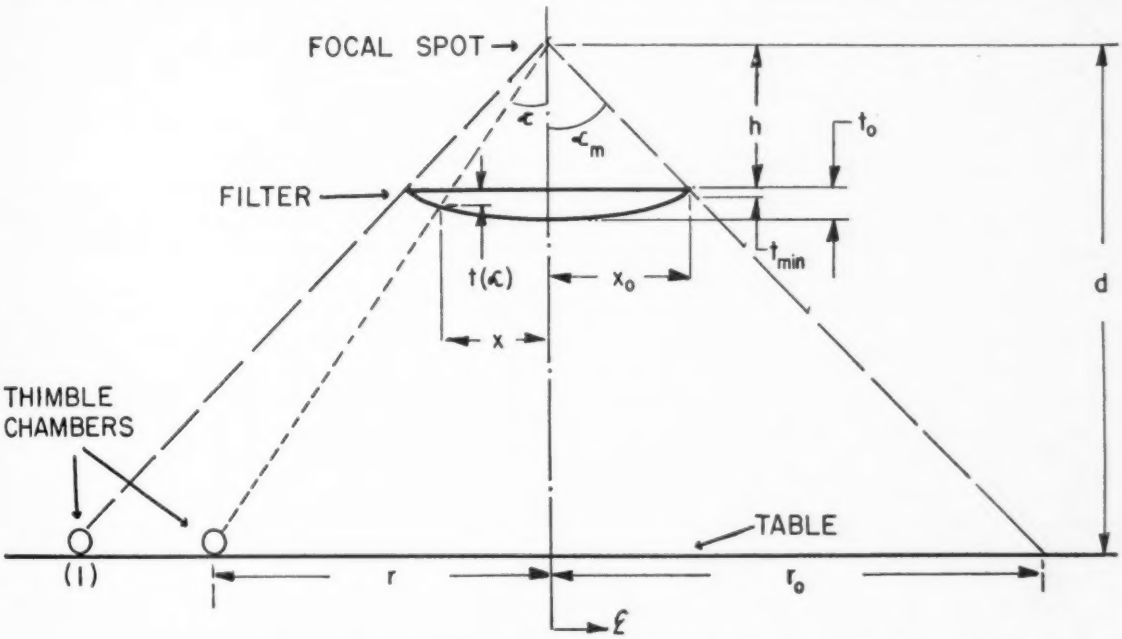

Fig. 1. Schematic drawing showing relative positions of the roentgen-ray target, filter, thimble chambers and table.

However, it is possible to obtain a simple empirical solution for $t(\alpha)$ in the following way. The minimum filter thickness will be at the edge. This minimum thickness, t_m, and the maximum radius, x_0, of the filter is chosen by the experimenter. The value of x_0 corresponds to the maximum field it is possible to attain with the roentgen-ray tube and its housing. A thimble chamber is placed at position (1) (see Fig. 1) on the table and a sheet of the filter material with thickness t_{min} is placed in the filter slot. A reading is then taken of the roentgen-ray intensity at position (1). The distance from the center for position (1) is

readings taken again. This process is repeated until the average of the four readings indicates that the intensity has risen by some predetermined amount, for example 3 per cent. At that time, one or more very thin sheets of the filter material are placed above the single sheet, t_{min}, already present. If the added sheets are sufficiently thin (for copper a thickness of 0.0017 inch was found convenient), it will be possible to reduce the intensity to approximately the value obtained at position (1). This process is continued with additional thin sheets added whenever required to reduce the intensity to corre-

spond to that in position (1). It will be found that near the center the intensity will change very slowly. Thus, one obtains the number of thin sheets appropriate for any angle α (or for the corresponding filter radius $x=h \tan \alpha$, where h is the distance from focal spot to the filter; also $x/h=r/d$). A typical table of values is given in Table 1. This table gives the data for a filter whose $t_{min}=0.5$ mm. Cu, and $X_0=11.0$ cm. One then proceeds to cut the thin sheets into circles of proper radius as follows: If a sheet was added when the thimble was at a distance r from the center, then the radius of that sheet is to be $x=hr/d$. This assembly of thin sheets and the original will produce a beam whose intensity will be uniform in the plane of the table.

TABLE I

RADII AND NUMBER OF SHEETS REQUIRED TO MAKE A FILTER FOR A TYPICAL CASE IN WHICH $t_{min}=0.5$ MM. CU, AND VOLTAGE IS 250 KV. (PEAK)

Copper sheet thickness = 0.0017 inch = 0.0432 mm. $t_{min}=0.5$ mm. $x_0=11$ cm. t_0 (at center) = 1.4 mm.

Radius r on Table (cm.)	Added Cu Sheets	Radius of Filter $x=\frac{rh}{d}$ (cm.)	Total Number of Sheets
48	1	10.48	1
46	1	10.04	2
44	1	9.61	3
40	2	8.74	5
36	3	7.86	8
34	1	7.42	9
30	3	6.55	12
28	1	6.11	13
26	2	5.68	15
20	1	4.37	16
16	2	3.49	18
8	1	1.75	19
6	1	1.31	20
4	1	0.87	21

Filters such as the one described above have been built for a 250 kv. (peak) Picker industrial type roentgen-ray unit. One filter was made of copper with $t_{min}=0.5$ mm. The added sheets were 0.0017 inch in thickness; X_0 was approximately 11.0 cm. There were about twenty-one thin sheets in addition to the one of 0.5 mm. The assembly was kept together very well by scotch tape.

Since the thickness of the filter is not uniform, the half-value layer also varies with distance from the center. The half-value layer at the center is 1.9 mm. Cu and varies down to a value of 1.4 mm. Cu at the periphery of the field.

After the filters were designed and built they were checked for uniformity of field intensity. Table II is typical of the results achieved. The intensity is uniform to within 2 to 3 per cent, which approaches the accuracy of the thimble chambers, as well as the constancy of output of the roentgen-ray unit.

TABLE II

RELATIVE INTENSITIES OF THE ROENTGEN-RAY BEAM AFTER PASSING THROUGH THE NON-UNIFORM FILTER, AS A FUNCTION OF POSITION IN THE PLANE OF THE TABLE

(250 kv., peak); 15 ma.; 100 cm. focus-object distance; 0.5 mm. Cu + 0.21 Cu inherent + 1.0 mm. Al + added Cu)

Distance from Center (cm.)	Leg No. 1	Leg No. 2	Leg No. 3	Leg No. 4	Center
50	20.8	20.0	19.2	20.0	21.0
40	20.0	20.0	19.8	20.0	20.0
30	20.2	19.2	19.6	20.4	19.8
20	20.0	19.6	20.0	20.8	19.8
10	20.2	19.8	20.0	20.4	19.8

The largest individual variations are due to azimuthal variation in the output of the roentgen-ray unit, and are also present when an ordinary filter is used. It generally requires only two to three hours to construct these non-uniform filters.

It is thought there may be some applications of these filters to certain types of surface therapy treatment. There will be a definite diminution of dose at the periphery of the treatment field as compared with the dose at the center. Another therapy application would be for use with a teleroentgen technique, which would require the use of a large angular field. It would be possible to design the filter to yield uniform skin dose

over the treatment field. A suitable phantom could replace the table in Figure 1. If it were important to reduce the half-value layer for surface treatments, one could construct the filter by using 1.0 mm. Al as the base and then add thin aluminium sheets. The technique for building filters is sufficiently simple that one could construct a series to suit the more common treatment field-focus-object distance combinations.

The authors wish to thank Dr. A. H. Dowdy for many helpful discussions.

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STEROID HORMONE THERAPY IN MAMMARY CARCINOMA*†

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THIS communication will summarize our experience with the use of steroid hormones in the palliative management of mammary carcinoma since 1946. Our particular interests have been in the relative efficiency of steroid hormones and roentgen radiation in the control of advanced cancer of the breast, the histopathological changes apparently induced by steroids in skeletal metastatic sites, and the possible correlation of the histopathology of the disease and its response to steroid hormones. This study was begun with a Grant-in-Aid from the National Cancer Institute, and since 1947 has been pursued in cooperation with the Subcommittee on Steroids and Cancer of the Committee on Research of the American Medical Association.

Only those patients with advanced cancer of the breast, usually with recurrent or metastatic disease, or both, have been admitted to this study. In a few instances, steroid treatment has been the primary method of management for patients with advanced local disease and metastases, but most of the patients treated have been those with metastatic disease following radical mastectomy. Over half of the patients so treated had also received prior palliative roentgen therapy for their recurrent or metastatic disease. Most of the patients have been seen on the Cancer Service of the Los Angeles County Hospital, and their management has been the function of a steroid clinic initiated in 1946. A few of the patients in this series have been seen in private practice by one of us.

This report is concerned only with objective response to treatment with steroid hormones and roentgen radiation, and specifically with the average longevity of the patients so treated. It seems obvious that the true measure of efficiency of a palliative agent should be in the increase in longevity achieved. It seems equally desirable to measure average longevity from the beginning of treatment until death rather than from the beginning of symptoms due to recurrent or metastatic disease to death. The latter method is more a measurement of the natural history of the disease rather than a gauge of the therapeutic efficiency of the palliative agent employed. We have made no effort to evaluate the subjective response of patients to steroid hormones. It is, of course, established that both androgenic and estrogenic hormones, particularly the former, have a considerable subjective effect because of their anabolic stimulus. The fallacy of evaluation of progress by subjective symptoms is well illustrated by the following case history.

Mrs. L.C., aged forty-two, was seen three years following radical mastectomy for a Stage II carcinoma of the breast. Her complaint was of pain in the right knee, and roentgenograms showed a small osteolytic focus in the lower end of the right femur. She was treated with 100 mg. of testosterone propionate three times weekly for three months, and complete relief of pain occurred within two weeks of beginning treatment. Roentgenographic examination of the femur, after three months of treatment, showed involvement of the lower third of the femur by an osteolytic process consistent with metastasis. The same dosage of hormone was continued for an additional three months, the patient continuing free of any pain, and at the end of this period the metastatic involvement occupied the lower half of the femur. The involved segment of femur was then treated with high voltage roentgen therapy for a tumor dosage of 500 r and roentgen examination

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three months thereafter showed satisfactory recalcification and healing of the process.

The highly variable growth pattern of mammary carcinoma is such as to produce extreme variations in its natural history, and thus large samples are necessary to obtain a significant measure of the efficiency of any therapeutic agent. The number of patients reported here is not large enough to permit final conclusions on the over-all efficiency of steroid hormones, but the results of treatment in general correspond with the pooled statistics already available from the Subcommittee on Steroids and Cancer.

ANDROGENIC STEROIDS

In Tables I, II and III is shown a summary of our experience with the use of androgenic steroids (testosterone propionate). Although 90 patients began treatment, in only 42 of these was treatment carried through for a minimum period of three months and a minimum total dosage of 3 grams of testosterone propionate by injection or, in a few instances, its equivalent by combined intramuscular injection and implantation of pellets. Almost all of the patients treated by androgenic steroids have been women in the premenopausal physiological phase, only a few postmenopausal patients having been so treated early in the course of the investigation. Significant regression of skeletal metastases was obtained in only 8 per cent of these patients. The regressions designated as "minor" are those observed by comparative roentgenographic studies, and were usually of no clinical importance. The androgens were more effective in producing major regression in soft tissue sites, such effect being achieved in 1 out of 3 patients. Progression of the disease was noted in over half of those patients with metastases to bone, and in 40 per cent of those presenting soft tissue sites of disease.

An attempt was made to compare the performance of androgenic steroids in producing palliation of the disease with groups of patients receiving no treatment, and those treated by roentgen radiation. As far as possible patients presenting comparable involvement by the disease were selected to form these two control series. Only 7 instances of untreated recurrent or metastatic breast cancer could be reviewed, at least in patients comparable to the treated groups of patients. In these 7 patients the average longevity, from the time of first observation to death, was 7.6 months. A series of 65 women treated by roentgen therapy showed an average longevity of nineteen months from beginning of treatment to death, as compared with a survival period of 11.4 months for patients treated by androgens.

Table I

ANDROGENIC STEROIDS IN MAMMARY CARCINOMA

Total treated	90
Excluded (inadequate treatment or data)	48
Suitable for evaluation	42
Alive	7
Dead	35
Average longevity	11.4 months
Average age	50 years

Table II

ANDROGENIC STEROIDS IN MAMMARY CARCINOMA

	Soft tissue	Bone
Major regression	33%	8%
Minor regression	16%	17%
Progression	40%	54%
Static	11%	21%

Table III

ANDROGENIC STEROIDS IN MAMMARY CARCINOMA

Treatment	No. of patients	Average longevity
Androgens	42	11.4 months
None	7	7.6 months
Roentgen irradiation	65	19.0 months

ESTROGENIC STEROIDS

In Tables IV and V our experience with the use of estrogenic steroids in 25 patients

TABLE IV

ESTROGENIC STEROIDS IN MAMMARY CARCINOMA

Suitable for evaluation	25
Alive	17
Dead	8
Average longevity	12 months
Average age	65 years

is shown, this form of therapy having been initiated as part of this study in 1948. The fact that estrogenic steroids have their most valuable palliative effect in women who are in the postmenopausal physiologic phase has been established by Nathanson and others, and all the patients reported here were so selected. The average longevity in these women was almost identical with that of those patients treated with androgenic steroids, or twelve months from beginning of treatment to death. The factor of selection by the criterion referred to above is reflected in the average age of this group of patients, sixty-five years. The estrogenic steroids did a notably better job of producing major regression of skeletal metastases than did the androgens, 20 per cent of bone metastases showing major regression with concomitant striking clinical improvement. In the soft tissue sites of disease, the estrogens produced almost 30 per cent major regressions, and in both soft tissue and skeletal sites minor regression was noted in about the same percentage of patients. Skeletal metastases showed active progression of lesions, usually with the appearance of new metastases while under treatment, in 50 per cent of these women.

These results with estrogenic steroids are those obtained with a minimum period of treatment of three months. Dienestrol was the agent used in the majority of patients, while a few received diethylstilbestrol. Dosage of both of these agents was 10 to 15 mg. per day. It now seems evident that proper evaluation of results requires a greater total dosage over a longer period of time, or, 4 gm. and six months respectively.

TABLE V

ESTROGENIC STEROIDS IN MAMMARY CARCINOMA

	Soft tissue	Bone
Major regression	28%	20%
Minor regression	28%	30%
Progression	33%	50%
Static	11%	0%

When effective, the most notable accomplishment of estrogenic steroids is seen in the long term control of soft tissue disease. Roentgen therapy is much less effective in the control of soft tissue lesions than in skeletal metastases, and so striking is the performance of estrogenic steroids in those postmenopausal patients who do show a favorable response, that it is now our practice to employ this agent as the primary method of palliation for soft tissue involvement. The occasional dramatic instance of such long term control is well illustrated by the following synopsis.

Mrs. K.T. had a left radical mastectomy in 1938 for a Stage II lesion. In 1940 she first developed local chest wall recurrence of her disease, and from then until 1946 multiple attempts were made to control the process by roentgen therapy and cautery surgery. When first seen by us in 1946, at age seventy, there were eight separate recurrent nodules studding the area over the upper third of the sternum and the left infraclavicular area. These nodules varied in size from a few millimeters to 3 cm. in diameter, the overlying skin showed extensive atrophy and telangiectasia from irradiation, and in the area there were multiple cicatricial postoperative sites. Estrogenic hormone in the form of diethylstilbestrol was begun with a dosage of 15 mg. daily. By the end of three months, the recurrences had completely regressed and the previously involved area was flat and smooth. She was placed on a maintenance dose of 5 mg. daily after four months, and after six months intermittent dosage of stilbestrol was employed. She remained free of disease until the end of 1949 when she escaped from observation.

She was next seen by another physician early in 1950 at which time a surgical procedure was done for a common bile duct obstruction by a calculus. At this time she had taken no estrogen for ten months, and she presented early recurrence of her chest wall lesions, roent-

genographic evidence of a metastasis to a lumbar vertebra, and at the surgical procedure rather extensive involvement of retroperitoneal nodes in the upper abdomen was noted, and a biopsy from one of these showed metastatic adenocarcinoma consistent with a primary site in the breast. Following the successful relief of the biliary obstruction, she was again placed on adequate doses of estrogenic steroids, with prompt regression of the local recurrences and roentgenographic evidence of healing of the metastatic lesion in the lumbar spine. Four and one-half years after beginning treatment she is well and active.

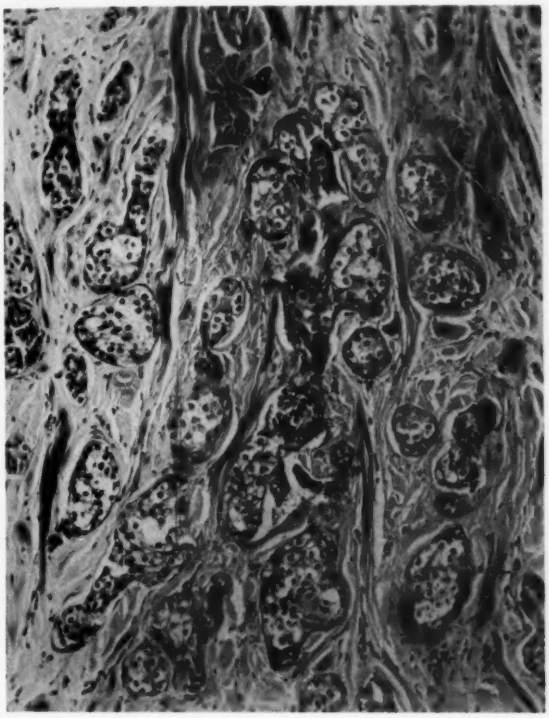

Fig. 1. Case D. V. Incisional biopsy of primary breast tumor before estrogen therapy.

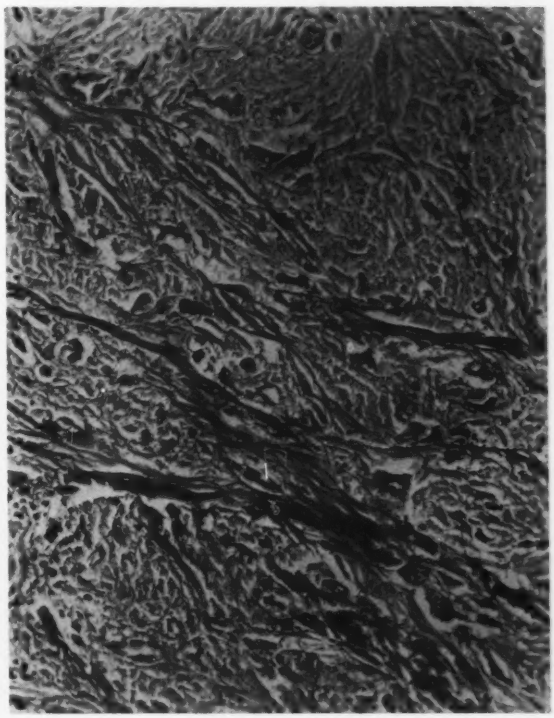

Fig. 2. Case D. V. Biopsy showing prominent fibrosis and cellular changes during estrogen therapy.

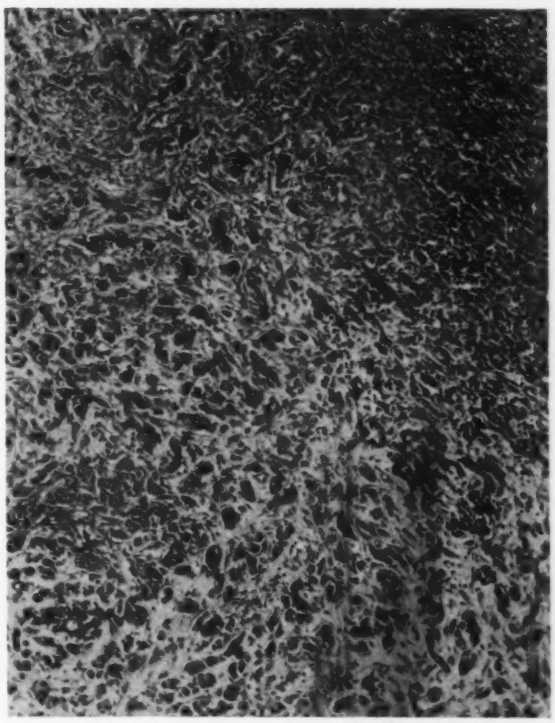

Fig. 3. Case F. G. Photomicrograph showing metastatic breast carcinoma in lymph node before start of androgen therapy.

COMBINED ESTROGENS AND ROENTGEN IRRADIATION

In Table VI is shown the average longevity of a small group of patients treated by intent with combined estrogens and roentgen irradiation and compared with the average longevity of the patients referred to above as "untreated" and "treated by roentgen irradiation only." Although the number managed by the combined method is too small for any valid conclusions, the extraordinary increase in

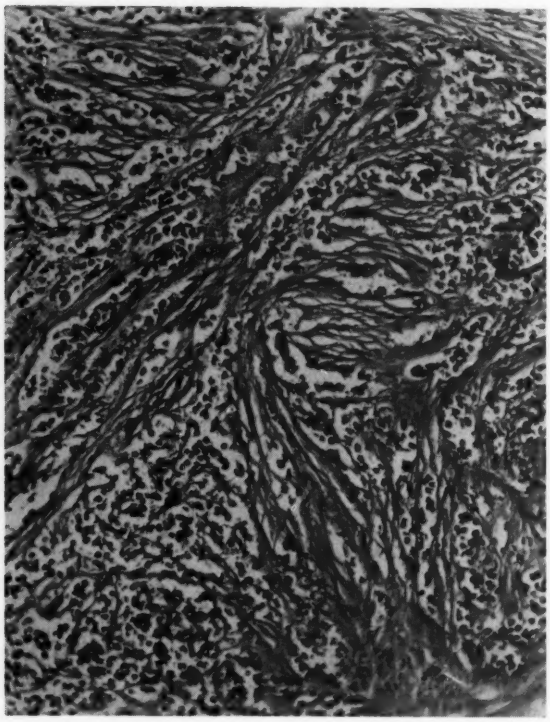

FIG. 4. Case F. G. Photomicrograph of metastatic breast carcinoma during androgen therapy.

average longevity to thirty-nine months is so impressive that we are continuing to treat a group of patients in this fashion.

SIDE EFFECTS

Both the androgenic and estrogenic steroids have side effects, but those resulting from the androgens are much more distressing. Common to both is edema, which occurred in approximately 1 out of 5 patients in our series. In 2 patients, progressive edema and hypercalcemia went on to a fatal termination, both patients having pre-existing cardiovascular disease with hypertension.

TABLE VI

COMBINED ESTROGENIC STEROIDS AND ROENTGEN IRRADIATION

Treatment	No. of patients	Average longevity
Untreated	7	7.5 months
Roentgen irradiation	65	19.0 months
Estrogens plus Roentgen irradiation	7	39.0 months

In our experience, the effective use of androgenic steroids is almost invariably accompanied by distressing side effects of such severity that it would have to be far more effective than it is to merit preference over roentgen radiation as a primary palliative agent. Hirsutism occurred in three-fourths of our patients, voice changes in

FIG. 5. Case E. N. Augmentation. Appearance of left breast after irradiation and before start of estrogen therapy.

FIG. 6. Case E. N. Augmentation. Appearance of breast three months after estrogen therapy. The protruding mass ulcerated and the patient died with widespread metastases four months after start of therapy.

over half of the group and acne, alopecia, and distressing increase in libido in various percentages of significant proportions.

The most common side effect of estrogenic steroids was uterine bleeding, usually not in any significant amount, and often controlled promptly by temporary in-

crease in dosage. About 1 in 10 patients was unable to tolerate dienestrol or diethylstilbestrol because of severe nausea, and most of this fraction tolerate a supply of natural estrogen. Three patients reported minor degrees of urinary incontinence.

HISTOPATHOLOGICAL STUDIES

One of us (F.E.D.) has reviewed and studied all available tissue prior to palliative management with steroids. Positive

Fig. 7. Case L. G. February 20, 1948. Destruction of body of the ilium, and the ascending ramus of pubis, before androgen therapy.

biopsies for carcinoma were obtained in each case, even though the original biopsy or surgical pathological tissues were available for study. In this way some information relating to the natural history of the tumor was obtained. Our histopathologic study was based on 15 cases in which estrogens were used, 19 cases in which androgens were used, 1 autopsy each on estrogen and androgen treatment and 2 cases in which serial biopsies were done. Augmentation of the cancer occurred in 2 cases. One operable primary breast carcinoma was treated.

The biopsies were obtained almost exclusively by the incisional approach rather than needle biopsy technique. The latter we found to be uniformly poor for adequate study. The sections were stained with hematoxylin and eosin and no special techniques were employed.

The results of the clinical data and longevity are summarized in Tables VII

Fig. 8. Case L. G. July 12, 1948. Healing of areas in Figure 7 during androgen therapy. Recurrent destruction of pubis is visible on roentgenogram of December 27, 1948. On roentgenogram of June 19, 1950, though new destructive areas have appeared, the pubis has healed. There is no evidence of recurrence in the ilium.

and VIII. In order to arrive at the approximate grade of malignancy we modified the method of Greenough.[2] The prognostic grade appeared to correlate with longevity fairly well. The average longevity in months

Fig. 9. Case A. W. March 21, 1949. No visible metastasis in the body of the third lumbar vertebra at onset of estrogen therapy.

TABLE VII

RESULTS AFTER ANDROGEN IN PATIENTS WITH HISTOPATHOLOGICAL STUDIES

Case	Age	Grade	Metastases		Response		Longevity
			Soft tissue	Bone	Soft tissue	Bone	
M.D.	72	Low	Soft tissue	Bone	Prog.	Prog.	Alive 39 months
L.R.	42	Medium	Soft tissue		Major regress.		Dead 6 months
M.M.	49	High	Soft tissue	Bone	Minor regress.	Minor regress.	Dead 8 months
M.S.	48	Medium	Soft tissue	Bone	Prog.	Prog.	Dead 19 months
F.H.	64	Medium	Soft tissue	Bone	Minor regress.	Prog.	Dead 7 months
N.I.	66	Medium	Soft tissue		No change		Dead 13 months
E.B.	57	High	Soft tissue		Prog.		Dead 7 months
B.McD.	45	Medium	Soft tissue		Slow prog.		Dead 10 months
V.W.	50	High	Soft tissue		Prog.		Dead 5 months
C.A.	60	Medium	Soft tissue	Bone	Prog.	No change	Dead 6 months
L.G.	44	Medium	Soft tissue	Bone	No change	No change	Alive 27 months
F.G.	49	Medium	Soft tissue	Bone	Slow prog.	Slow prog.	Dead 8 months
L.C.	40	Low		Bone		Prog.	Alive 21 months
L.K.	35	Medium		Bone		Prog.	Dead 7 months
K.B.	46	High	Soft tissue		Prog.		Dead 6 months
L.P.	43	Medium	Soft tissue		Major regress.		Alive 9 months
R.W.	42	Low	Soft tissue	Bone	Major regress.	Major regress.	Alive 14 months
R.G.		Low	Soft tissue		Major regress.		Dead 25 months

TABLE VIII

RESULTS AFTER ESTROGEN IN PATIENTS WITH HISTOPATHOLOGICAL STUDIES

Case	Age	Grade	Metastases		Response		Longevity
			Soft tissue	Bone	Soft tissue	Bone	
A.W.	66	Low	Soft tissue	Bone	Major regress.	Major regress.	Alive 24 months
K.Mc.	72	Medium		Bone		Major regress.	Dead 33 months
B.W.	48	Low	Soft tissue		Minor regress.		Alive 12 months
C.W.	70	Medium	Soft tissue		No change		Alive 19 months
D.A.	59	Low	Soft tissue		Major regress.		Alive 24 months
E.E.	82	Medium	Soft tissue		No change		Dead 16 months
E.F.	49	Low	Soft tissue	Bone	Minor regress.	Minor regress.	Alive 11 months
N.W.	64	Low	Soft tissue	Bone	Major regress.	Major regress.	Alive 9 months
E.N.	41	High	Soft tissue	Bone	Augment.	Augment.	Dead 4 months
M.B.	76	Medium		Bone		Minor regress.	Alive 11 months
E.H.	78	Medium	Soft tissue		Minor regress.		Alive 20 months
C.H.	67	Medium		Bone		Prog.	Dead 9 months
M.Mc.	74	Medium	Soft tissue	Bone	Prog.	Prog.	Dead 7 months
C.B.	78	Medium	Soft tissue		Prog.		Dead 6 months
E.R.	49	Low		Bone		Major regress.	Alive 19 months

for our hormone treated carcinomas by grade is:

High grade	$5\frac{1}{4}$ months
Medium grade	$13\frac{1}{2}$ months
Low grade	$19\frac{1}{2}$ months

Since autopsies were obtained in only 2 cases, these figures are only approximations. The marked differences in longevity for various degrees of anaplasia may be nothing more than an expression of comparable variants in natural history. Conversely, distinct augmentation was seen in

patients with high grade breast carcinoma by the use of estrogens; both were forty years of age, both died of generalized metastases within six months after the start of hormone treatment.

The need for a well studied series of untreated cases of carcinoma of the breast was evident at the onset of this study. Sequential biopsies, of course, would give a great deal of information but are not always practical. Here again the information ob-

Fig. 10. Case A. W. June 13, 1949. After three months of therapy, metastatic lesion is now visible due to deposition of calcium about the periphery of the osteolytic area.

tained may only express the biological balance between the host and her neoplasm.

Many investigators have well reported clinical and roentgenological findings in steroid treated cases of breast carcinoma. Few, if any, have fully discussed the histopathologic findings. Those authors who have discussed the cytologic changes have drawn no conclusions.

Recently Godwin and Escher,[1] in a study of 32 patients with primary breast carcinoma who had been treated for twenty-

Fig. 11. Case A. W. March 22, 1950. Almost complete sclerosis of osteolytic metastasis which has remained unchanged.

eight days prior to radical mastectomy with steroid hormones, reported that "the breast lesions reveal no pathognomonic histological changes demonstrable." They did, however, notice a few cases which showed more prominent fibrosis and cytoplasmic vacuolation than could be expected in control cases. In our study the increase

Fig. 12. Case K. Mc. June 5, 1948. Extensive destruction of the right ilium, acetabulum and left ischium, before estrogen therapy.

FIG. 13. Case K. Mc. April 3, 1950. Partial healing of the involved areas in Figure 12 during estrogen therapy.

in the amount of fibrosis was a very prominent feature (see Fig. 1 and 2). This patient (D.A. in Table VIII) refused surgery in March, 1949, for bilateral carcinoma of the breast and was placed on estrogen treatment. Early in the course stilbestrol was used, which was later replaced by dienestrol and, currently, she is on tri-para-anisyl chloroethylene. She remains well and works daily as a domestic. Several questions arise: Is the increasing fibrosis and degeneration of the cancer cells an expression of the natural history in regard to the tumor-host relationship; is the use of estrogens or androgens augmenting this naturally occurring fibrosis; or are the cytologic alterations evidence that the breast is a target organ, and therefore subject to fluctuations of sex hormones?

Until more material is available for study from untreated cases, these questions cannot be answered with assurance, but it seems evident from our material that the most notable effect of steroid therapy is the stromal sclerosis observed in those lesions which have exhibited a favorable clinical course. In some of these the sclerosis replaces large areas of metastatic deposits, although small foci of pyknotic, compressed but viable cancer cells are regularly found even in the most sclerotic of such areas. Evidence of specific cytotoxic effect is lacking. A histopathologic study is in progress and will soon be submitted for publication.

CONCLUSIONS

1. Roentgen irradiation of recurrent and metastatic mammary carcinoma is, in general, more effective than is the primary use of the steroids so far employed, particularly in premenopausal women.

2. The use of androgenic steroids for premenopausal patients should be reserved for those with involvement too widespread for roentgen therapy, and for radioresistant processes.

3. Both estrogens and androgens are more effective in soft tissue than in skeletal sites of disease.

4. The most effective use of steroids is found in the employment of estrogens in postmenopausal patients with soft tissue involvement. For such patients we prefer estrogens as a primary method of treatment.

5. The most promising results which we have obtained, in terms of increased longevity, is in a small group of postmenopausal patients treated by a combination of estrogenic steroids and roentgen irradiation.

6. There is a distinct correlation between increase in longevity and lack of anaplasia in the patients treated by steroids, but we are unable to determine whether this is entirely a reflection of a variable natural history, or a more favorable therapeutic effect on more differentiated neoplasms.

7. The most notable histologic effect of steroid therapy is a stromal sclerosis in neoplastic sites. Evidence of a specific cytotoxic effect is lacking.

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A METHOD USING I^{131} FOR THE DETERMINATION OF ABNORMAL THYROID MORPHOLOGY*

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BEFORE the introduction of I^{131} into the diagnosis of thyroid disease the only procedures available for the estimation of morphological characteristics of thyroid glands consisted of the very crude method of palpation or the much more drastic surgical exploration.

After I^{131} became available on a large scale it was theoretically possible to map the I^{131} accumulating regions of a thyroid gland by means of the gamma rays emitted. But there were no instuments available having sufficient sensitivity to do this with some degree of precision with a relatively innocuous dose of I^{131}.

In order to obtain a useful method of examination for determining the morphology of active thyroid tissue it was necessary to develop suitable instrumentation. A greatly improved method, using I^{131} of studying some of the morphological characteristics of the frontal profile of the human thyroid gland in its normal and abnormal states is presented.† A step in the instrument development and its clinical application has been described by Cassen, Curtis and Reed,[4] and Allen, Libby and Cassen.[2] It was found that a crystal of calcium tungstate produces scintillations bright enough for ready detection by a photomultiplier tube when exposed to extremely low intensity gamma rays emitted by small amounts of I^{131}. The high intrinsic amplification of the photomultiplier tube and an auxiliary amplifier produce countable electrical pulses. On account of the excellent scintillation efficiency of calcium tungstate a large fraction of the scintillations produced can be counted. The high tungsten content of a calcium tungstate crystal makes it possible to obtain high absorption of incident 0.36 mev. gamma rays from I^{131} in a very small volume. This concentrated sensitivity is taken advantage of by surrounding the crystal with a collimator with a 3/16 inch aperture. Thereby, the counter is only sensitive to gamma rays coming from a very small region of an extended source.

A manual technique of utilizing the high spatial resolution attainable with such a detector to determine the frontal profile of the thyroid gland of a patient administered 100 to 250 microcuries of I^{131} has been described by Allen, Libby and Cassen.[2] Gamma-ray activity was measured over $\frac{1}{4}$ inch diameter circles on points of a $\frac{1}{4}$ inch lattice over the gland and its immediate periphery. A series of isocount points around the periphery was selected and a line was drawn to represent the margin of the gland. This technique proved to be time consuming and arduous, both for the technician and patient. More recent developments in instrumentation described by Cassen, Curtis, Reed and Libby[5] permit visualization of the gland, or the distribution of I^{131} in it, to be obtained by an automatic scanner and recorder. Such automatically obtained pictures are referred to as scintigrams.[3] They are obtainable on a patient with a normal size thyroid gland in fifteen to thirty minutes. The scintigram can be used to estimate the weight of the gland by a method far superior to palpation as described by Allen and Goodwin,[1] using point by point plotting of the gland area.

The method here described is employed in the following instances:

† The initial instrumentation development was performed under contract No. AT-04-1-GEN-12 between the Atomic Energy Commission and The University of California at Los Angeles.

* From the Radioisotope Unit, Wadsworth General Hospital, Veterans Administration Center, and the School of Medicine, University of California at Los Angeles.

FIG. 1. Demonstrates the patient in supine position, the head of the directional scintillation tube above the neck and the rack, motors, table and prints with the scintigram.

1. Hyperthyroidism.
   a. Diffusely enlarged glands prior to therapy with I^{131} in an effort to estimate the correct therapeutic dose of I^{131}.
   b. Nodular ("toxic"). This includes patients with normal I^{131} uptake who are clinically hyperthyroid and may not have palpable nodules.
   c. Recurrent hyperthyroidism following surgical treatment of I^{121} therapy.
2. Goiter, including substernal goiter.
3. Solitary palpable nodules in order to determine whether I^{131} is accumulated or not.
4. Carcinoma of the thyroid before and after surgical treatment in order to determine I^{131} pick-up of metastases or remaining thyroid tissue.
5. Aberrant thyroid tissue.

An initial series of illustrative cases is presented.*

PROCEDURE

The procedure of handling patients is simple and may be conducted under routine hospital conditions. When a clinical diagnosis of thyroid disease is made, diagnostic uptake studies are performed with a 2 microcurie administered dose. The details of this procedure are described elsewhere.[7] If outlining procedures are recommended, a dose ranging between 100 and 250 microcuries of I^{131} is administered orally. The dose used within these limits depends upon the avidity of the gland for I^{131} (it is desirable to have 60–70 microcuries I^{131} in the gland at the time of outlining). The patient returns in twenty-four or forty-eight hours for the scintigram. He is placed on an adjustable operating table in a supine position (Fig. 1). If the patient is apprehensive he is given a suitable sedative. The head is extended and fixed in a comfortable position. The tip of the collimator of the scintillation tube is brought in close proximity to the surface of the neck in such a way that there is no interference with the sweep of the tube by the chin or upper anterior thorax. A trial run is then made across the center of the gland. The frequency of either the pen or the printer stroke* is then adjusted so that

* The instrument used in this series of patients was the original automatic scanner developed by the Atomic Energy Project, School of Medicine, University of California at Los Angeles. This represents a cooperative effort between the Atomic Energy Project, University of California at Los Angeles, and the Radioisotope Unit, Wadsworth General Hospital, Veterans Administration Center, Los Angeles, to evaluate instrument developments for clinical use.

* Recently the visual contrast of the scintigrams has been improved by the use of a relay to print a line through a strip of varitype carbon paper instead of producing a pip with a writing pen as originally described. This method makes a record without base lines which makes for a distinct improvement in the observable contrast.

in the most active portion of the gland the individual strokes on the paper are not confluent but spaced about 1 millimeter apart. This is accomplished by adjusting the rate of movement of the scanning tube and selection of a suitable scaling ratio between counts and pen strokes. A binary scaler can be connected to the pen relay so that the scaling ratio is a power of 2 up to 256 counts per pen stroke.[5] By spacing the strokes at least 1 millimeter apart, areas representing an increased concentration of I^{131} will be recorded as more dense. Non-iodine accumulating areas displacing an appreciable amount of normal tissue will yield a pale or less dense area. An effort is made to keep the ratio of counts to the number of strokes recorded as high as possible so that the random effect of radioactive emission is regularized. This effect enables an even spacing between the strokes, thereby producing an improved visual contrast. Maximum resolution is attained when the photomultiplier and auxiliary amplifier settings produce the highest ratio of counts from the gland to background. This is accomplished, for the most part, by having adequate activity in the gland and approximating the tube to the surface of the neck as closely as possible, thereby minimizing the effect of the inverse square law.

When the proper adjustments are made the procedure is started 2 to 3 cm. above or below the gland. The tube sweeps horizontally, extending laterally over the edge of the gland by several centimeters. The tube is guided on the power driven rack over the surface of the gland measuring the activity of the gland. The 3/16 inch aperture measures a $\frac{1}{4}$ inch strip of the gland with each crossing. This is recorded as about a $\frac{1}{4}$ inch wide strip of strokes. When the entire gland is scanned, a scintigram or anterior profile results.

Because of the reluctance to administer 100 microcuries or more of I^{131} to a healthy individual, the morphology of a normal gland is simulated in Figure 2. A latex model of a human thyroid gland was impregnated with 100 microcuries of I^{131} and a scintigram obtained.

In Figures 2 through 7, in order to bring out the anatomical relationship to better advantage, the trachea, thyroid cartilage and the hyoid bone have been sketched in diagrammatically.

Case 1. M.B. (GH 14689).

Figure 3 is a scintigram of a twenty-eight year old man with severe thyrotoxicosis and a diffusely enlarged thyroid gland. He was treated with 7.2 millicuries of carrier-free I^{131} (7,000 rep. per gram thyroid tissue). Four months following the initial therapeutic dose

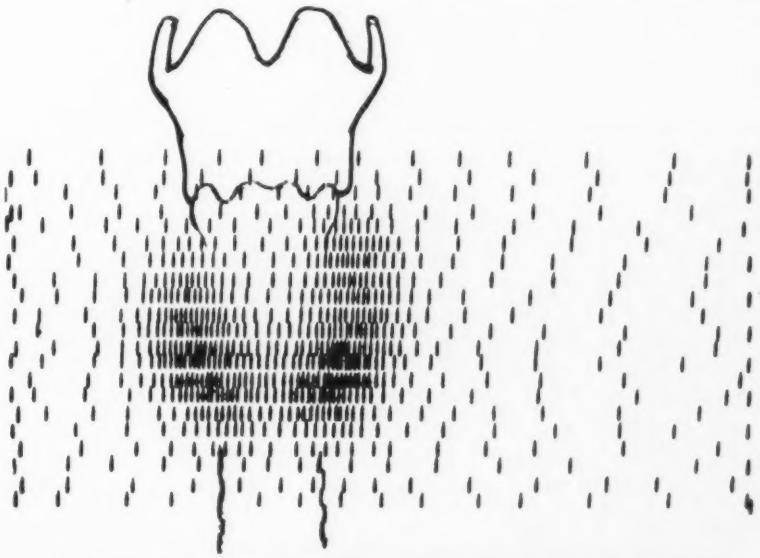

Fig. 2. Scintigram of latex model of normal thyroid gland.

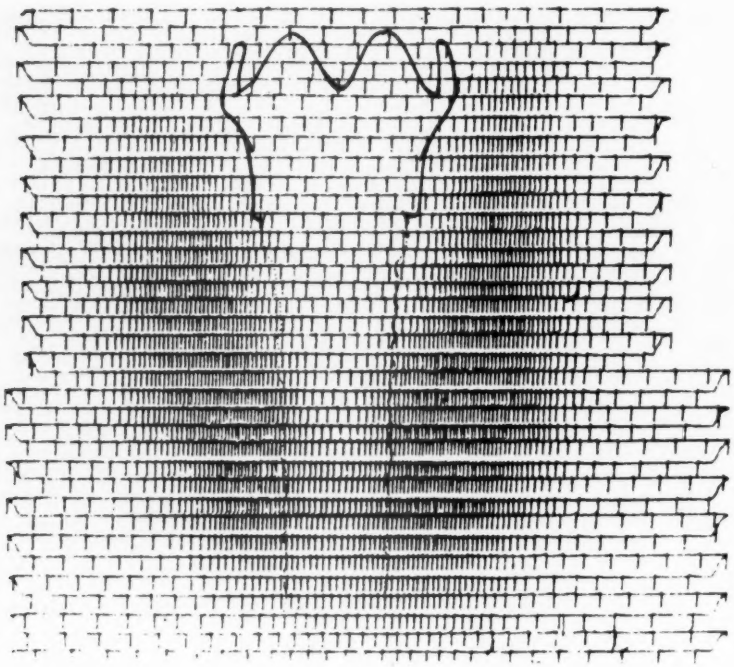

FIG. 3. Scintigram of diffusely enlarged thyroid gland.

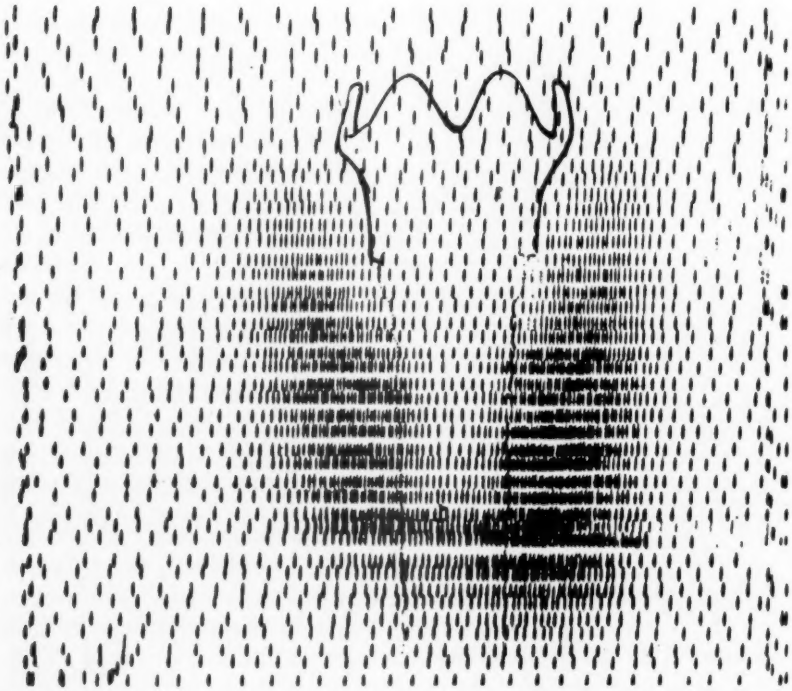

FIG. 4. Scintigram of same thyroid gland as in Figure 2, four months after inadequate therapy.

he was still hyperthyroid and was given another 100 microcuries of I^{131} for the purpose of obtaining a scintigram and of estimating the weight of the gland. Figure 4 represents the scintigram obtained at that time. Attention is called to the symmetrical shrinkage of the gland.

Case II. J.R. (GH 25988).

Figure 5 is a scintigram of a fifty-four year old retired dentist who had a history of Graves' disease, treated by "subtotal" thyroidectomy in 1944. The patient had suffered a posterior myocardial infarction in 1949 and presented cholesterol 180 milligrams per cent. Diagnostic I^{131} uptake studies revealed an uptake of 31 per cent in six hours and a maximum concentration of I^{131} in the gland of 46 per cent in twenty-four hours.

Physical examination revealed a nodule 5 cm. in diameter which was palpable at the superior pole of the right thyroid lobe. The scintigram demonstrates an I^{131} accumulating nodule with complete suppression of I^{131} uptake by the remainder of the gland. This phenomenon was first described by Cope *et al.*[6] by means of radioautographs.[6] During preparation for surgery with Lugol's solution and phenobarbital, the patient gained 15 pounds in weight with markedly diminished nervousness, irritability and diaphoresis. His bowel movements decreased from two to three per day to one per day and from a loose to a well formed stool. At operation a nodule, 6 cm. in diameter, was removed from the right lobe of the thyroid. Atrophy of the remaining right lobe and left lobe of the thyroid was described by the operating surgeon.

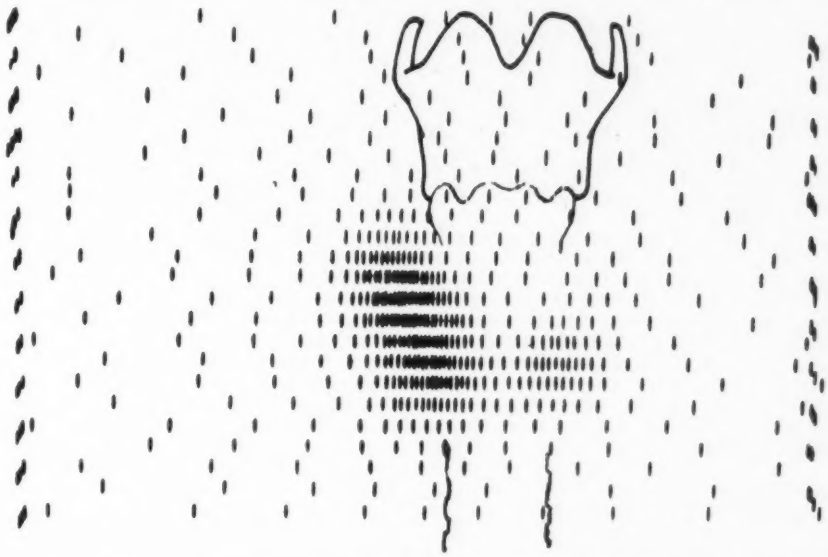

Fig. 5. Scintigram of patient seven years after subtotal thyroidectomy for thyrotoxicosis.

himself with angina decubitus on the present admission.

The scintigram demonstrates the effect of the total removal of the left upper lobe of the thyroid with a small amount of residual tissue of the left lower lobe. The isthmus, right upper and lower lobes are seen and represent regeneration of the posterior aspect of these lobes left at operation. Unfortunately, adequate lateral views are impossible for judging depth of the tissue.

Case III. S.N. (GH 26726).

Figure 6 is a scintigram of a fifty-two year old man who entered with a history of a 15 pound weight loss in the past month, slight increase in perspiration, nervousness, irritability, diarrhea and heat intolerance. Protein bound iodine 9.0 micrograms per cent, basal metabolic rate minus 39 per cent, total serum

Case IV. H.P. (GH 22588).

Figure 7 is a scintigram of a sixty-two year old man who was found to have diabetes mellitus by his company doctor in February, 1951. Physical examination revealed a nodule, 3 cm. in diameter, which appeared to arise from the right lobe of the thyroid gland and extended inferiorly. There were no signs or symptoms of

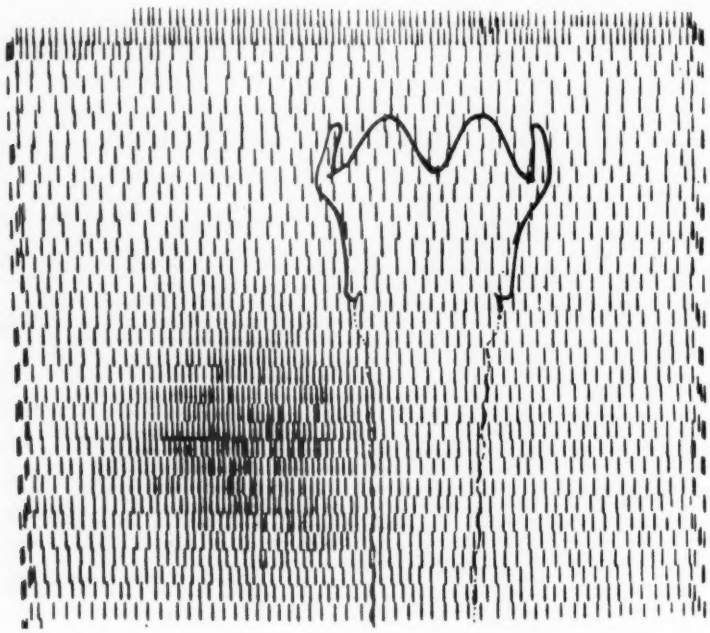

FIG. 6. Scintigram of a "toxic" nodule.

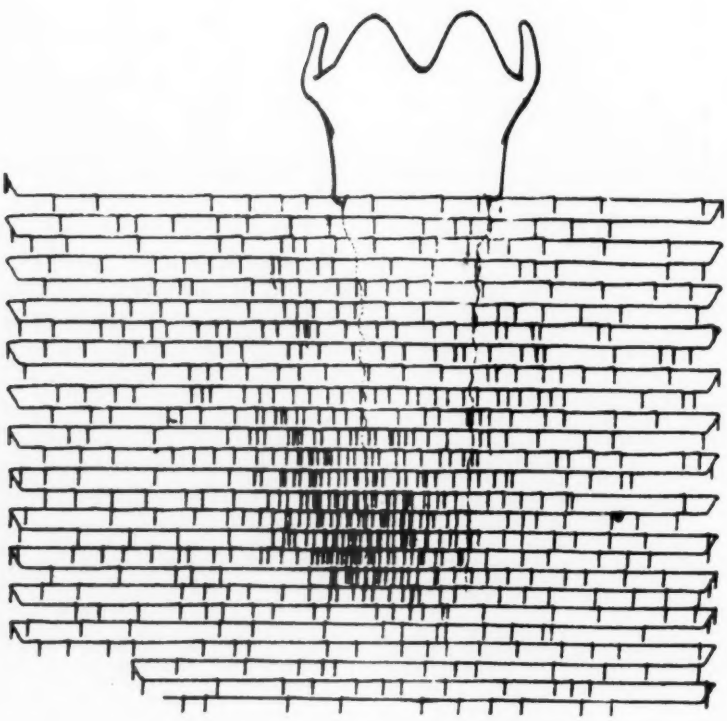

FIG. 7. Scintigram of a "toxic" nodule.

hyperthyroidism. Protein bound iodine was 4.5 micrograms per cent, basal metabolic rate plus 1 per cent and serum cholesterol 258 milligrams per cent. The patient's diabetes was difficult to control despite a rigid diet and insulin regimen. There were frequent episodes of glycosuria and hypoglycemia. Several combinations of insulin (protamine zinc insulin, regular insulin mixtures, and modified protamine insulin [NPH]) failed to stabilize the diabetes. For this reason the patient was admitted to this hospital. The scintigram in April, 1951, demonstrated an I^{131} accumulating area which corresponded to the previously palpated nodule. Surgical removal of the nodule was performed. There were no other nodules seen at surgery. Since his discharge the patient's diabetes has been easily controlled on 28 units of NPH insulin.

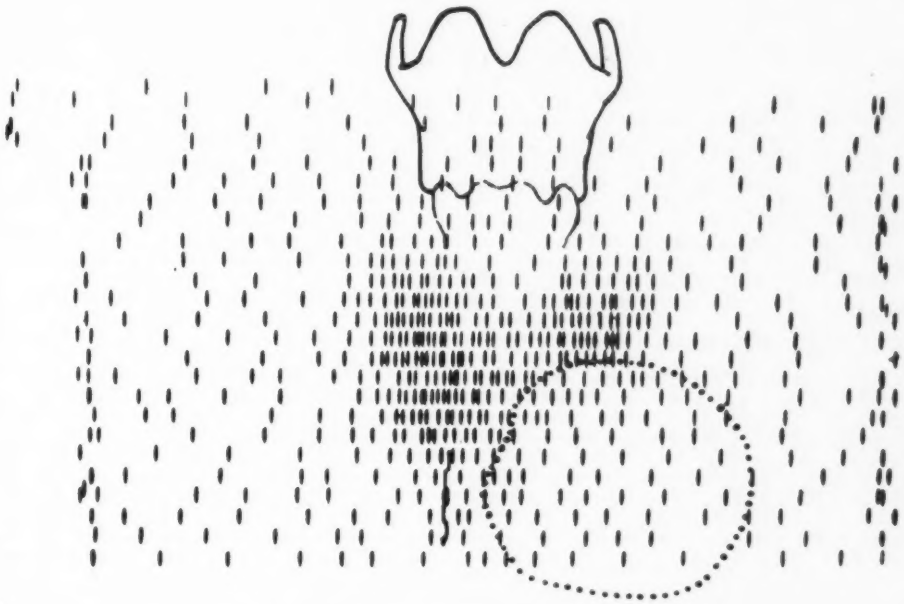

Fig. 8. Scintigram of a "non-functioning" nodule with pressure atrophy of the left inferior pole of the thyroid.

Case v.

Figure 8 is a scintigram of a forty-five year old woman who became aware of a nodule in the left suprasternal area four months ago. There were no signs or symptoms suggestive of thyroid disease and the physical examination revealed no abnormalities except the nodule in the neck. Protein bound iodine, basal metabolic rate and serum cholesterol were within normal limits. The scintigram demonstrates pressure atrophy of the inferior pole of the left lobe.

DISCUSSION

The whole field of radiographic examination is a branch of what might be called "non-destructive testing," to borrow an engineering term. As applied to human patients, non-destructive testing is an extreme instance of "minimal destructive testing," some techniques producing essentially no injury or inconvenience to the patient, others having various degrees of usually temporary injurious or annoying effects. Many well known ingenious methods have been developed to increase the scope of radiographic minimal destructive testing methods as diagnostic aids in clinical medicine. Despite the enormous utility and scope of these methods, there are many parts of the body that are as yet not readily susceptible to them, either for morphological or functional examination. Any new method or instrumentation which increases the scope of minimal destructive testing in clinical medicine is obviously

greatly desired. The doses of I^{131} used in these studies enable the method to be classified in the minimal destructive testing class and it appears to approach closely the non-destructive testing limit.

The method described has become a routine clinical procedure in this hospital. It is being relied upon more and more by internists and surgeons who are interested in the size and shape of the patient's thyroid gland and in aberrant thyroid tissue. No other clinical method enables the surgeon to know whether a palpable nodule accumulates I^{131} or whether it does not. Clinically non-demonstrable nodular areas, I^{131} accumulating or non-accumulating, have been demonstrated by means of the scintigram. Substernal extension of thyroid tissue can also be brought to the attention of the surgeon before operation. Regeneration of thyroid tissue, both normal or carcinomatous, following ablative treatment can be accurately detected on follow-up examinations by the method described in this paper.

The directional scintillation counter, which is used on the automatic scanner, is less sensitive than the wide angle tube used for diagnostic tracer studies.[2] The doses of I^{131} employed to obtain scintigrams are much higher than those used for diagnostic tracer studies in this laboratory, although they are comparable to those previously considered to be in tracer dose range. This relatively larger dose of I^{131} has kept us from using it to outline thyroid glands in healthy control subjects. With further improvements in sensitivity of the scintillation counters and refinements in timing devices it is hoped to reduce the amounts of I^{131}. It is also planned to correlate the visual profile of the gland (scintigram) with the actual amount of I^{131} present in the whole gland or portions of the gland. This will enable the clinician to follow shrinkage of thyroid glands treated with I^{131} and to study phenomena such as uneven distribution of I^{131} in thyroid glands and the problem of translocation or re-utilization of I^{131} in a quantitative manner.

SUMMARY

1. A method is presented for demonstration of the frontal profile of the thyroid gland by a "minimal destructive technique."

2. The method uses I^{131} and the directional scintillation counter.

3. The doses employed range between 100 and 250 microcuries of carrier-free I^{131}.

4. The indications for the procedure with illustrative cases are discussed.

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This work would not have been fully realized without the able assistance on instrumentation problems of Mr. Lawrence Curtis of the University of California at Los Angeles School of Medicine, Atomic Energy Project, and the technical assistance of Mrs. Lucille E. Shoop, R. N., Miss Shirley Jarrett, R. N., and Mrs. Elsie Youtcheff, B.A., all of the Veterans Administration Hospital.

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Janeway Lecture Committee: Douglas Quick, Chairman, New York, N. Y., G. Failla, New York, N. Y., Frederick W. O'Brien, Boston, Mass.

Representatives on American Board of Radiology: Douglas Quick, New York, N. Y., B. P. Widmann, Philadelphia, Pa., Frederick W. O'Brien, Boston, Mass.

Committee on Arrangements: Wendell G. Scott, Chairman, St. Louis, Mo., Axel N. Arneson, St. Louis, Mo., Edwin C. Ernst, St. Louis, Mo., LeRoy Sante, St. Louis, Mo.

Representatives on National Committee for Radiation Protection: Edith H. Quimby, New York, N. Y., John E. Wirth, Pasadena, Calif.

Thirty-fifth Annual Meeting: Chase Hotel, St. Louis, Mo., April 19, 20, 21 and 22, 1953.

EDITORIALS

ROENTGEN-RAY PROTECTION DESIGN

ACCOMPANYING the increased application of roentgen-ray equipment and techniques is the growing need for specially designed diagnostic and treatment rooms. One of the major problems involved in any building program of this type is that of protecting against roentgen rays the persons working with the equipment and those in adjoining areas. Many publications are available to assist in the solution of this problem, but none have undertaken to explain certain assumptions and recommendations nor have they included detailed design specifications. Extensive computations and analyses of all phases of the problem have resulted in the development of detailed procedures for the design of barriers for roentgen-ray protection.

Roentgen-ray protection recommendations, sample design problems, and methods for computing barrier thickness, are presented in a new Handbook that should prove valuable to architects and engineers planning structures in which roentgen-ray equipment is to be used.[1] The primary factual data and basic principles necessary for designing shielded roentgen-ray installations included in the publication are based on the recommendations of the National Committee on Radiation Protection,[2] a committee composed of the nation's outstanding experts in radiation protection.

In general, rules and recommendations in the field of roentgen-ray protection must be based on the limited data that are available in the literature. Additional changes may be expected in the future as roentgen-ray equipment is improved and modified or as roentgen-ray techniques are altered. At that time a more detailed analysis of the equipment and operating conditions for a particular installation may permit some reduction of the barrier requirements.

Roentgen-ray protective barriers can be divided into two types: a primary barrier, providing protection against the useful radiation or beam; and a secondary barrier, providing protection against the secondary and leakage radiation passing through the tube-housing. Thus, if a roentgen tube is fixed in position, the portion of the wall or floor struck by the radiations passing through the tube-housing aperture, cone, or diaphragm (the useful beam) will require a primary protective barrier. Secondary protective barriers will be required for all other areas receiving the radiations escaping through the tube-housing (direct radiation) and the radiations originating in the irradiated material (secondary radiations). If the tube may be aimed in every direction, all walls must be considered as subject to useful radiations and therefore require primary protection barriers.

Roentgen-ray protection techniques are based on the recommendations of the International Commission on Radiological Protection. This group has proposed that the permissible exposure rate for roentgen rays is 0.30 roentgen (r) per week, measured in air. This exposure may be distributed uniformly over the working time in a week or may be obtained in larger short time exposures, provided the total does not exceed 0.30 r in any one week. It should be noted that this is not a tolerance dose, because

[1] X-ray Protection Design. By H. O. Wyckoff and L. S. Taylor. National Bureau of Standards Handbook 50 (May, 1952). For sale by the Superintendent of Documents, Washington 25, D. C. Price, 15 cents.

[2] Medical X-ray Protection up to Two Million Volts. National Bureau of Standards Handbook 41 (March, 1949). For sale by the Superintendent of Documents, Washington 25, D. C. Price, 20 cents.

it is not known that the body can tolerate any radiation. However, at such exposure levels no ill effects to the individual have been revealed to date that indicate the need for revision to a lower level requirement. Thus, protective barriers must be designed to limit exposure rates to within these recommendations—preferably much less.

Four basic principles of protection design must be included in every preliminary consideration of a new roentgen-ray installation. (1) The major portion of the protection should be as near the roentgen tube as possible. It is usually recommended that a large amount of the protection be incorporated in the tube-housing if this is compatible with the mechanical design requirements for mobility. This arrangement does not obviate the use of other barriers but does mean a marked reduction in the total weight and volume to be required.

(2) It is desirable to restrict the direction of the useful beam. Only the area struck directly by the useful beam requires primary barrier protection; all other parts need only secondary protection. For instance, by restricting the direction of the useful beam toward the floor, the weight of doors may be reduced and the number of sheets of lead glass in observation and other windows may be decreased.

(3) It is usually considered advisable to compute all barrier thickness requirements for a full eight hour day. In spite of the fact that immediate requirements may dictate a thinner barrier, the cost of adding layers to existing protection (because the equipment is to be used for longer periods) far exceeds the expense of installing thicker barriers during the initial construction.

(4) Lead is the major protective material in the low voltage range and is also used in the high voltage range when space is limited. Concrete, because of its structural length, has been favored in the high energy region where the absorption is principally a mass effect. In some isolated cases, where the voltages are very low, ordinary plaster walls may suffice for secondary barriers. In other instances, steel may be useful and economical for mobile barriers in low potential installations and for doors in rooms housing high voltage apparatus.

Numerous experimental data appear in the literature from which radiation attenuation curves and tables may be obtained for the useful beam. The information is usually developed for a particular material, such as concrete or lead, and for various ranges of roentgen-ray potentials. In addition, a consideration is made of the voltage waveform, direction of the roentgen-ray beam with respect to the electron beam, and the inherent filtration associated with the experiment in all cases for which this information is available. All of these factors are important and, when possible, should not be overlooked in the design of adequate, yet economical protection. Several tables are presented in Handbook 50, including tables of primary protection-barrier requirements for potentials of 75 to 250 kv. (peak), 400, 500 and 1,000 kv. (peak), satisfied by various thicknesses of lead, and barrier requirements for potentials of 500, 1,000, and 2,000 kv. (peak), satisfied by concrete.

The ordinate of the curves included in the Handbook gives the dose rate of the useful beam beyond the barrier in roentgens per minute at a point 1 meter from the target for a tube current of 1 milliampere. The abscissa is in terms of the thickness of the specified barrier material that reduces the dosage rate of the 1 ma. beam shown by the ordinate. Barrier requirements at other distances and radiation outputs are computed on the basis of the dose rate at 1 meter. If the tube current is increased above 1 ma., the barrier requirements will also be increased; if the distance between the tube and the point to be protected is increased, the barrier requirements will be decreased. Thus, the curves indicate directly the barrier thickness required to reduce the dose rate to the permissible value of 10^{-4} r/min. for 1 ma. at 1 meter from the target.

The most important consideration in the design of roentgen-ray installations is naturally the type of operation performed by the apparatus. Design recommendations are made accordingly. For instance, roentgenoscopes are required to have a lead-glass barrier, so that, if all other recommendations are followed, the treatment room will require only secondary barrier protection. Roentgenographic equipment normally does not have a self-contained primary protective barrier as do the roentgenoscopic units and thus requires protection for all walls and the floor. In addition, many units incorporate extreme flexibility of movement of the tube-housing so that all of the protection must be the primary barrier type. The same conditions are generally true of units used in 250 kv. (peak) deep therapy, and because of the increased energy, more stringent recommendations are required. Additional factors must be taken into consideration when using equipment for 1 million volt therapy. In this instance, it is recommended that the treatment room be located in an isolated area that is supported sufficiently to withstand the weight of the equipment. Furthermore, the motion of the tube should be restricted so that the roentgen-ray beam can be pointed only at the most distant points of occupied space and never toward adjoining rooms, above the horizontal, or toward the observation window.

An example of the design recommendations, described in full detail in Handbook 50, is a 250 kv. (peak) deep therapy installation. At the time the equipment is supplied by the manufacturer, its roentgen-ray beam may be pointed in any direction. Unless restrictions are placed on the mechanical motion of the tube, all walls, floor, and ceiling should be primary protective barriers. As the beam cannot be pointed at all of these walls for the full forty-eight hour week, it is worth while to consider the proportion of time each protective barrier may be struck by the useful beam. If it is possible to obtain all treatment conditions without directing the beam toward any one given barrier, a mechanical restriction may be incorporated in the tube motion. This area then requires only a secondary protective barrier with a consequent reduction in the thickness of the material. Even if no such restrictions are permissible, it may still be possible to limit the period the beam will be pointed toward the ceiling, for instance, to a maximum of one-eighth the total time the unit will be used. Under these conditions, the primary protective barrier thickness originally computed for the ceiling may be reduced by three half-value layers (the half-value layer is defined as the thickness of a material required to reduce the emergent radiation to one-half the dose rate of the incident radiation). For design purposes it should be assumed that the machine will operate at its full rating of 250 kv. (peak) and 15 ma. whenever used.

For purposes of illustration, a typical room in which the equipment is to be used is described as being about 18 feet long, 14 feet wide, and 9 feet high. A hallway borders one of the walls, which also includes an entrance way. Ideally, no windows should be in the outside walls as they may give inadequate shielding and therefore would require protective baffles. The control booth for the roentgen-ray apparatus should be as far removed as possible from the roentgen tube. The degree of occupancy of all adjoining rooms must also be considered. It is further recommended that in designing the barriers, the roentgen-ray units be considered to operate for a forty-eight hour week. In some instances, it may be possible to restrict the motion of the tube to a comparatively small treatment area. This move could result in reduction from primary to secondary barrier protection for as many as two complete wall areas. However, no matter what the restriction on motion may be, the largest amount of protection is required for the floor of the treatment room. It is recommended for a tube pointing permanently downward that multiple layers of protection should be placed in a circle of 2 or 3

feet radius with its center directly below the roentgen tube target.

It should be noted that the computations upon which the recommendations are based were derived from existing data. The computations, in all cases, provide adequate protection; in fact, in some instances, they provide overprotection. In order to be on the safe side, and because of the somewhat limited data now available, protection was computed for a long work period (forty-eight hours per week), a large radiation field, the maximum permissible personnel exposure (0.30 r per week), and safe assumptions of the quality of the direct and scattered radiations. These assumptions are being examined continually and in more detail to determine, if possible, where future additional information or changes in tube-housing protection may permit revisions leading to more economical designs.

Lauriston S. Taylor, *Chief*
Atomic and Radiation Physics Division
National Bureau of Standards
Washington, D. C.

ROLLA GEORGE KARSHNER
1888–1952

DR. ROLLA GEORGE KARSHNER was born June 6, 1888, in Big Rapids, Michigan. He died July 12, 1952, of carcinoma of the lung and liver. From the University of Michigan, he received his Bachelor's degree in 1915, and his M.D. in 1917. He interned at the University of Michigan Hospital under Dr. Udo J. Wile. During World War I, he served as First Lieutenant in the Medical Corps, stationed at Camp Beauregard, Louisiana. After his military discharge he returned to the University of Michigan Hospital for training in Radiology under Dr. J. G. Van Zwalen-

burg. On December 31, 1918, he was married to Elva Jahns, a graduate in Literature of the University of Michigan.

Dr. Karshner came to Los Angeles in 1919 where he practiced Roentgenology until the time of his death. In addition to an office practice, his staff connections included: Childrens Hospital (thirty-three years); Barlow Sanatorium (thirty years); Sante Fe Hospital, Consultant (twenty years); Good Samaritan Hospital (eleven years); and University of California at Los Angeles Health Service, Consultant (ten years). His society memberships included: Los Angeles County Medical Society, California Medical Society, American Medical Association, Los Angeles Academy of Medicine, Los Angeles Radiological Society, American Roentgen Ray Society, Radiological Society of North America, American College of Radiology, and the Trudeau Society. He contributed most worthily to the medical literature.

Throughout his career Dr. Karshner maintained exacting scientific standards and thoughtful study of his cases. He combined with this a quiet unobtrusive behavior and a cordial friendliness to all associates. Thus he had throughout the thorough respect of radiologists and his clinical associates, as a roentgenologist, and their warm personal regard and affection, as a friend. This is attested by his prolonged satisfactory service in his staff appointments. It was gratifyingly evident in the many spontaneous comments of cordial respect of associates which one encountered throughout the years. His versatility was evident in his various staff appointments and in the diverse types of men of medicine who regarded him highly.

Dr. Karshner suffered an attack of coronary thrombosis in 1944. Most revealing of his character is the manner in which he conserved his strength for the essential human services in the years which followed.

He was most generous of his time and knowledge in educational activities with residents and interns. Residents in Radiology of the Veterans Administration Hospital in this community, and their supervisors were deeply indebted to him for his support in instruction in the Roentgenology of Pediatrics. The writer has had special opportunity to note the soundness of his teaching in this field.

Dr. Karshner will be missed greatly, but his associates and bereaved ones may take consolation in the fact that he belongs to that select group whose career does not end with death but lives on in the careers of those whom he has so favorably influenced.

As a final tribute one may fittingly quote from an obituary written by Dr. Simon Jesberg, a senior otolaryngologist of exacting standards, not prone to light enthusiasms:

"There are not many medical practitioners who can be accredited with saving so many human lives directly and indirectly by wise decisions as was this quiet little man."

Ray A. Carter, M.D.

MOORE LOWRY ALLEN
1893–1952

WE RECORD, with sorrow, the passing of Moore Lowry Allen, on August 2, 1952. For many years he had been handicapped by a cardiac ailment, but death came suddenly and without premonitory warning, while he was at work in his office. With his death, not only Utah, but national radiology has lost a staunch protagonist whose place will be difficult to fill.

Born in Mount Pleasant, Utah, April 3, 1893, he was the only son of Dr. Samuel H. and Ida May Lowry Allen, and received his preliminary scholastic training in Provo and Salt Lake City, Utah. He attended the

University of Maryland and graduated from the University of Pennsylvania, with honors, in 1924. Following internship at the Policlinic and Medico-Chi and Childrens Hospitals of Philadelphia, he engaged in private practice in Winter Quarters and Clear Creek, Utah, from 1927 until 1931, when he received a fellowship in Radiology at the Hospital of the University of Pennsylvania. Upon completion of that training, in 1933, he became Radiologist of the Protestant Episcopal Hospital in Philadelphia, and Associate in Radiology on the teaching faculty of the University of Pennsylvania. In 1939 he resigned those appointments to open an office for private practice, first in the Judge Building, later in the Medico-Dental Building, in Salt Lake City. When the University of Utah established a four year course in the Faculty of Medicine, Dr. Allen was appointed the first Professor of Radiology, retiring from that position in 1946. At various times he was Radiologist to the Utah Valley Hospital, Provo, the Geneva Steel Co., Geneva, Utah, and the Regional Office of the U. S. Veterans Administration in Salt Lake City, as well as being Consulting Radiologist to the Latter Day Saints Hospital, Salt Lake City, Utah, Idaho Falls, Idaho, and the State Mental Hospital, Provo, Utah. During World War I he served as an enlistee in the Naval Hospital Corps, and for services as Radiologist of the Medical Advisory Draft Board for Utah, during World War II, he was cited by President Franklin D. Roosevelt and Governor Herbert D. Maw.

A member of the Church of Jesus Christ of Latter Day Saints, he served as a missionary for the Church in Germany, and in the United States, from 1913 until 1916.

On June 22, 1920, he was married to Anna H. Hunt, of Alameda, California, from which union, twin sons, Dr. Samuel M. Allen and Bradford H. Allen, were born. Divorced in 1945, he subsequently married Emily V. Stasinski of Philadelphia, by whom he had two children, Myra E. and M. Lowry, Jr. In addition, he is survived by his mother, Mrs. Samuel H. Allen, Salt Lake City, and three sisters, Mrs. Horace W. Aven, Los Angeles, Mrs. Joseph S. Jones, Salt Lake City, and Mrs. George Chrissy, Tokyo, Japan.

Dr. Allen's society memberships were legion. He was a Diplomate of the American Board of Radiology, Fellow of the American College of Radiology, member of the American Roentgen Ray Society, Radiological Society of North America, Rocky Mountain Radiological Society and Past President of the Utah State Radiological Society. He was a member of the American Medical Association, Utah State Medical Association and Salt Lake County Medical Society. He was Delegate from Utah of the Association of American Physicians and Surgeons and President of the Utah Alumnae Group of the University of Pennsylvania. He was also a member of the Utah Chapter, Sons of the American Revolution, of the University Club and was President of the Ensign Club, Salt Lake City, from 1949 to 1950.

A physician of positive and engaging personality, he was held in the highest esteem by the profession in Utah. He rarely missed a meeting of either the County or State medical organizations and his counsel and advice, always based on deeply rooted conviction, received close attention and careful consideration. He was an ardent supporter of the private practice of medicine, particularly radiology, and in his passing, this specialty has lost a devoted advocate.

Angus K. Wilson, M.D.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Barton R. Young, Germantown Hospital, Philadelphia 44, Pa. Annual meeting: Netherland Plaza Hotel, Cincinnati, Ohio, Sept. 29–Oct. 2, 1953.

AMERICAN RADIUM SOCIETY
Secretary, Dr. J. E. Wirth, 635 Herkimer St., Pasadena 1, Calif. Annual meeting: Chase Hotel, St. Louis, Mo., April 19–22, 1953.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. D. S. Childs, 713 E. Genesee St., Syracuse 2, N. Y. Annual meeting: Netherland-Plaza Hotel, Cincinnati, Ohio, December 7 to 12, 1952.

AMERICAN COLLEGE OF RADIOLOGY
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6, Illinois.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. T. Leucutia, Harper Hospital, Detroit 1, Mich. Annual meeting: 1953, to be announced.

ALABAMA RADIOLOGICAL SOCIETY
Secretary, Dr. J. A. Meadows, Jr., Medical Arts Bldg., Birmingham 5, Ala. Meets time and place Alabama State Medical Association.

ARIZONA RADIOLOGICAL SOCIETY
Secretary, Dr. R. Lee Foster, 15 E. Monroe, Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

ARKANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

ATLANTA RADIOLOGICAL SOCIETY
Secretary, Dr. Albert A. Rayle, Jr., 478 Peachtree St., N.E., Atlanta, Ga. Meets monthly, except during three summer months, on second Friday evening.

BROOKLYN ROENTGEN RAY SOCIETY
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, October through April.

BUFFALO RADIOLOGICAL SOCIETY
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

CENTRAL OHIO RADIOLOGICAL SOCIETY
Secretary, Dr. F. A. Riebel, 15 West Goodale St., Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Columbus Athletic Club, Columbus, Ohio.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. Elbert K. Lewis, 6337 S. Harvard Ave., Chicago, Ill. Meets second Thursday of each month, October to April inclusive at the University Club.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Mortimer Lubert, 10515 Carnegie Ave., Cleveland 6, Ohio. Meetings at 6:45 P.M. on fourth Monday of each month from October to April.

COLORADO RADIOLOGICAL SOCIETY
Secretary, Dr. William Curtis, 1612 Tremont, Denver, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

CONNECTICUT VALLEY RADIOLOGIC SOCIETY
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday October and April.

DALLAS-FORT WORTH ROENTGEN STUDY CLUB
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. J. C. Cook, Harper Hospital, Detroit, Mich. Meets monthly first Thursday, October to May, at Wayne County Medical Society Building.

EAST BAY ROENTGEN SOCIETY
Secretary, Dr. Dan Tucker, 434 30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

FLORIDA RADIOLOGICAL SOCIETY
Secretary, Dr. A. Judson Graves, 2002 Park St., Jacksonville, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

GEORGIA RADIOLOGICAL SOCIETY
Secretary, Dr. Robert M. Tankesley, 218 Doctors Bldg., Atlanta, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

GREATER MIAMI RADIOLOGICAL SOCIETY
Secretary, Dr. Maurice Greenfield, Ingraham Bldg., Miami, Fla. Meets third Wednesday of each month at Veterans Administration Building.

HOUSTON RADIOLOGICAL SOCIETY
Secretary, Dr. F. M. Windrow, 1205 Hermann Professional Bldg., Houston, Texas. Meets fourth Monday each month.

IDAHO STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Alfred M. Stone, St. Lukes Hospital, Boise, Idaho. Meets annually at same time as Idaho State Medical Association.

ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. Stephen L. Casper, 1101 Maine St., Quincy, Ill. Meets three times a year.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

IOWA X-RAY CLUB
Secretary, Dr. James McMillan, 1104 Bankers Trust Bldg., Des Moines, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. The scientific section is held in the autumn.

KANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Willis L. Beeler, M.D., 700 Kansas Ave., Topeka, Kansas. Meets in spring with State Medical Society, and in winter on call.

KENTUCKY RADIOLOGICAL SOCIETY
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

KINGS COUNTY RADIOLOGICAL SOCIETY
Secretary, Dr. Marcus Wiener, 1430 48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

LOS ANGELES RADIOLOGICAL SOCIETY
Secretary, Dr. John B. Hamilton, 210 N. Central Ave., Glendale 3, Calif. Meets second Wednesday each month at Los Angeles County Medical Association Building.

LOUISIANA RADIOLOGICAL SOCIETY
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

MAINE RADIOLOGICAL SOCIETY
Secretary, Dr. C. F. Miller, Central Maine General Hospital, Lewiston, Maine.

* Secretaries of societies are requested to send timely information promptly to the Editor.

Miami Valley Radiological Society
Secretary, Dr. G. A. Nicoll, 134 Apple St., Dayton, Ohio. Meets second Friday of fall and winter months.

Mid-Hudson Radiological Society
Secretary, Dr. J. W. Walton, Horton Memorial Hospital, Middletown, N. Y. Meets 8:30 P.M., fourth Tuesday each month, September to May.

Milwaukee Roentgen Ray Society
Secretary, Dr. T. J. Pfeffer, 839 N. Marshall St., Milwaukee 2, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. John R. Hodgson, Mayo Clinic, Rochester, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

Mississippi Radiological Society
Secretary, Dr. John W. Evans, 621 High Street, Jackson 2, Miss. Meets third Thursday of each month at the Rotisserie Restaurant at 6:30 P.M.

Nassau Radiological Society
Secretary, Dr. Joseph J. La Vine, 259 North Grand Ave., Baldwin, N. Y. Meets second Tuesday of the month in February, April, June, October and December.

Nebraska Radiological Society
Secretary, Dr. R. W. Blanchard, 1216 Medical Arts Bldg., Omaha, Nebr. Meets fourth Thursday of each month at 6 P.M. at Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. Stanley M. Wyman, Massachusetts General Hospital, Boston, Mass. Meets monthly on third Friday, Harvard Club.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. Harold W. Jacox, 622 W. 168th St., New York 32, N. Y. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. J. E. Hemphill, 1420 E. Fifth St., Charlotte 4, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement.

Northeastern New York Radiological Society
Secretary, Dr. John F. Roach, Albany Hospital, Albany, N. Y. Meets in Albany area on second Wednesdays of October, November, March and April. Annual meeting will be held in May or June, 1953.

Northern California Radiological Club
Secretary, Dr. G. A. Fricker, Sacramento County Hospital, Sacramento, Calif. Meets at dinner last Monday, every second month, except June, July and August.

Ohio State Radiological Society
Secretary, Dr. Willis S. Peck, 1838 Parkwood Ave., Toledo 2, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. John R. Danstrom, Medical Arts Bldg., Oklahoma City, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. J. Richard Raines, 214 Medical-Dental Bldg., Portland 5, Oregon. Meets monthly from October to June on the second Wednesday of each month at 8:00 P.M. at the University Club.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
Secretary, Dr. George P. Keefer, American Oncologic Hospital, Philadelphia 4, Pa. Meets first Thursday of each month, at 5 P.M., from October to May in Thompson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary, Dr. Donald H. Rice, Western Pennsylvania Hospital, Pittsburgh 24, Pa. Meets 6:00 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Radiological Section, Baltimore Medical Society
Secretary, Dr. H. Leonard Warres, 2337 Eutaw Place, Baltimore 17, Md. Meets third Tuesday each month, September to May, inclusive.

Radiological Section, Connecticut Medical Society
Secretary, Dr. William A. Goodrich, 85 Jefferson St., Hartford 6, Conn. Meetings are held bi-monthly.

Radiological Section, Medical Society of the District of Columbia
Secretary, Dr. U. V. Wilcox, 915 Nineteenth St., N. W., Washington 6, D. C. Meets Medical Society Library, third Thursday of January, March, May and October at 8:00 P.M.

Radiological Section, Southern Medical Association
Secretary, Dr Roy G. Giles, Temple, Texas.

Radiological Society of Greater Cincinnati
Secretary, Dr. Harry K. Hines, 2508 Auburn Ave., Cincinnati 19, Ohio. Meets monthly from September to June on first Monday of each month at 7:30 P.M. at the Cincinnati General Hospital.

Radiological Society of Hawaii
Secretary, Colonel Alexander O. Haff, M.C., Tripler Army Hospital, Honolulu, T. H. Meets third Friday of each month at Tripler Army Hospital.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

Radiological Society of New Jersey
Secretary, Dr. Nicholas G. Demy, 912 Park Avenue, Plainfield, N. J. Meets annually at Atlantic City at time of State Medical Society and mid-winter at Elizabeth, N. J.

Richmond County Radiological Society
Secretary, Dr. W. F. Hamilton, Jr., University Hospital, Augusta, Ga.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Robert J. Bloor, 260 Crittenden Blvd., Rochester, N. Y. Meets last Monday of each month, September through May, at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. Maurice D. Frazer, 1037 Stuart Bldg., Lincoln, Nebr. Next annual meeting, Shirley-Savoy Hotel, Denver, Colo., August 20, 21 and 22, 1953.

St. Louis Society of Radiologists
Secretary, Dr. Francis O. Trotter, Jr., 634 N. Grand Blvd., St. Louis 3, Mo. Meets fourth Wednesday each month, except June, July, August and September.

San Antonio-Military Radiological Society
Secretary, Dr. Hugo F. Elmendorf, Jr., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets Brook Army Medical Center Officers Mess first Monday of each month.

San Diego Radiological Society
Secretary, Dr. Rex Uncapher, 7720 Girard Ave., La Jolla, Calif. Meets first Wednesday of each month at the University Club.

San Francisco Radiological Society
Secretary, Dr. I. J. Miller, 2680 Ocean Avenue, San Francisco 27, Calif. Meets quarterly.

Section on Radiology, California Medical Association
Secretary, Dr. Calvin L. Stewart, 2330 First Ave., San Diego 1, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. Harold L. Shinall, St. Joseph's Hospital, Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Bay Radiological Society
Secretary, Dr. Ford Shepherd, 526 Soquel Avenue, Santa Cruz, Calif. Meets second Wednesday each month.

South Carolina Radiological Society
Secretary, Dr. Henry E. Plenge, Spartanburg General Hospital, Spartanburg, S. C. One meeting with South Carolina Medical Association in May, others arranged by President.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, Newell Hospital, Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas. Next meeting: San Antonio, Texas, January 23 and 24, 1953.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7:00 p.m. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 p.m., September to May, Service Memorial Institute.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

Virginia Radiological Society
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. John N. Burkey, 555 Medical-Dental Bldg., Seattle 1, Wash. Meets fourth Monday of each month from September through May.

Westchester Radiological Society
Secretary, Dr. Walter J. Brown, Northern Westchester Hospital, Mt. Kisco, N. Y. Meets on third Tuesdays of January and October and on two other dates.

Wisconsin Radiological Society
Secretary, Dr. Irving I. Cowan, 425 E. Wisconsin Ave., Milwaukee 2, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-Ray Study Club of San Francisco
Secretary, Dr. Charles E. Duisenberg, Palo Alto Clinic, 300 Homer Ave., Palo Alto, Calif. Meets third Thursday at 7:45 p.m., January to June, Lane Hall, Stanford University Hospital; July to December, San Francisco Hospital.

Cuba, Mexico and Central America

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Sociedad Mexicana de Radiologia y Fisioterapia
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

Sociedad Radiológica Panameña
Secretary, Dr. L. Arrieta Sanchez, Apartado No. 86, Panama, R. de P. Meets monthly in a department of radiology of a local hospital, chosen at preceding meeting.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 p.m.
Medical Members' meeting, on third Friday in each month at 5:00 p.m., 32 Welbeck St., London, W 1. Annual Meeting, London, England, December 4 and 5, 1952.

Faculty of Radiologists
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 p.m. at the Royal Society of Medicine, 1 Wimpole St., London.

Canadian Association of Radiologists
Honorary Secretary-Treasurer, Dr. Jean Bouchard, Suite 305, 1555 Summerhill Avenue, Montreal 26, Que. Meetings January and June.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Société Canadienne-Française d'Electrologie et de Radiologie Médicales
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

College of Radiologists (Australia and New Zealand)
Honorary Secretary, Dr. Alan R. Colwell, c/o British Medical Agency, 135 Macquarie St., Sydney, N.S.W.

South America

Asociacion Argentina de Radiologia
Secretary, Dr. Lidio G. Mocsa, Avda. Gral Paz 151, Córdoba, Argentina. Meetings held monthly.

Sociedad Argentina de Radiologia, Junta Central, Buenos Aires
Secretary, Dr. Oscar F. Noguera, Santa Fe 1171, Buenos Aires. Meetings are held monthly.

Sociedad Argentina de Radiologia, Filial del Litoral, Sede, Rosario
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 19 ha 663 Italia St., Rosario, Santa Fe.

Sociedad Argentina de Radiologia, Filial del Sur, Sede, La Plata
President, Prof. Dr. Jose P. Uslenghi, La Plata. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Centro Sede, Cordoba
President, Prof. Dr. David L. Caro, Corro 86, Cordoba. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Norte, Sede, Tucuman
President, Dr. Julio Mendez Valladares, Rivadavia 358, Tucuman. Meets monthly.

Sociedad Argentina de Radiologia, Filial de Cuyo Sede, Mendoza.
President, Dr. J. A. Orfila, Hospital Central, Mendoza. Meets monthly.

Sociedade Brasileira de Radiologia Medica
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

Sociedade Brasileira de Radioterapia
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9:00 p.m. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

Sociedad Colombiana de Radiologia
Secretary, Dr. Alberto Torres Focke, Av. 34, No. 17–34, Bogota, Colombia. Meets last Wednesday of each month.

Sociedad Peruana de Radiologia
Secretary, Dr. Julio Bedoya Paredes, Apartado 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

Sociedad de Radiologica, Cancerologia y Fisica Medica del Uruguay
Secretary, Dr. Arias Bellini, Av. Agraciada 1464, Piso 13, Montevideo, Uruguay.

Continental Europe

Société Belge de Radiologie
General Secretary, Dr. S. Masy, 111 Avenue des Allies, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

Société Française d'Electro-Radiologie Médicale, and its branches: Société du Sud-Ouest, du Littoral Méditerranéen, du Centre et du Lyonnais, de

L'Ouest, de l'Est, et d'Alger et d'Afrique du Nord
Secretary-General, Dr. A. Dariaux, 9 bis, Boulevard Rochechouart, Paris IX°, France.

Ceskoslovensk společnost pro rëntgenologii a Radiologii v Praze
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

Polish Society of Radiology
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

Gdansk Section, Polish Society of Radiology
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10:30, X-Ray Dept., Akademia Gdansk.

Wrocław Section Polish Society of Radiology
Secretary, Dr. R. Marciniak, Akad. Medyczna Wrocław, 68 Curie-Skłodowska St., Wrocław, Poland. Meets first Sunday of each month, X-Ray Department, Akademia Medyczna Wrocław.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad
USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Schweizerische Röntgen-Gesellschaft (Société Suisse de Radiologie)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

Deutsche Roentgen-Gesellschaft
Secretary, Dr. Peter Kröker, (22a) Essen-Helsingen, Westpreussenstrasse 21. Meets annually in different towns.

Societa Italiana dr Radiologia Medica
Secretary, Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

India

Indian Radiological Association
Secretary, Dr. R. F. Sethna, Navsari Building, Hornby Road, Bombay 1, India.

POSTMORTEM CHEST TELE-ROENTGENOGRAMS

To the Editor:

In the February, 1952, issue of the AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE, there is an article by Dr. Poppel and co-authors on "A Plea for Routine Postmortem Chest Teleroentgenograms" in which the first historical references for such use were dated 1940. I would like to add that we have made routine postmortem films of the chest since 1934, beginning at the Michigan State Sanatorium, Howell, Michigan; at Hopemont Sanitarium in West Virginia; and at the San Fernando Veterans Administration Hospital in California. References for such use were published in our papers of 1936 (Salkin, D., Cadden, A. V., and McIndoe, R. B. Postmortem bronchography. *Tubercle*, 1936, *18*, 71–80; Salkin, D., Cadden, A. V., and McIndoe, R. B. Postmortem bronchography. *Am. Rev. Tuberc.*, 1936, *34*, 649–662). In fact, for some time we even did routine bronchography postmortem and for several years induced routine postmortem pneumothorax to study certain pathological phenomena which had important roentgen applications.

As stated by Dr. Poppel and his co-authors, we have found postmortem films of inestimable value in teaching roentgenology and have advocated their routine use for years. We would suggest that a simpler method for positioning the patient than by the suspension with a halter is to construct a simple chair which we described in our paper noted above published in the *American Review of Tuberculosis*.

DAVID SALKIN, M.D.
Veterans Administration Hospital
San Fernando, California

To the Editor:

I hope that you may be able to publish the letter from Dr. David Salkin and thereby indicate that his publications precede the one in 1940 by Hampton and Castleman which we quoted in our paper entitled "A Plea for Routine Postmortem Chest Teleroentgenograms," which appeared in the February, 1952, issue of this JOURNAL.

M. H. POPPEL, M.D.
114 East 54th Street
New York 22, New York

MID-WINTER RADIOLOGICAL CONFERENCE

The Fifth Annual Mid-Winter Radiological Conference, sponsored by the Los Angeles Radiological Society, will be held at the Ambassador Hotel, Los Angeles, California, on Saturday and Sunday, February 21 and 22, 1953. A banquet preceded by cocktails will be held at the Ambassador Hotel on Saturday evening, February 21. Hotel reservations should be made as soon as possible through the Convention Manager, Ambassador Hotel, Los Angeles. The out-of-state speakers will be Dr. Fred J. Hodges, Ann Arbor, Michigan, Dr. H. Dabney Kerr, Iowa City, Iowa, and Dr. Ira H. Lockwood, Kansas City, Missouri. Conference reservations may be made through Dr. M. M. Haskell, 615 Times Building, Long Beach 2, California. The Conference fee is $20.00, and the dinner will be $6.00 per plate. Courtesy cards are available to radiological residents and radiologists in military service by pre-registration.

EASTERN CONFERENCE OF RADIOLOGISTS

The Eastern Conference of Radiologists will hold its meeting at the Warwick Hotel, Philadelphia, Pennsylvania, on March 6 and 7, 1953. Radiologists who expect to attend this Conference are invited to write to Dr. Rolfe M. Harvey, Bryn Mawr Hospital, Bryn Mawr, Pennsylvania, for their advance registrations.

RADIOLOGICAL HEALTH PROTECTION

A series of three two-week courses in Radiological Health Protection, including technical laboratory procedures, will be presented in Cincinnati, Ohio, commencing January 19, 1953. Each succeeding two-week course is dependent upon information gained in the preceding weeks. However, the student's previous training and experience may permit him to enter directly the second or third two-week program. Thus, an individual, depending upon his particular qualifications and need, may take a two-week, a four-week or a six-week course.

This program, free of tuition, is offered to qualified applicants by the Public Health Service at its Environmental Health Center. Its purpose is to assist health department employees and key personnel in other governmental or private organizations to achieve a working knowledge of the hazards and problems related to use of roentgen rays, radioelements, neutron fluxes, and particle accelerators.

For further information and registration write to the following: Chief, Radiological Health Training Section, Environmental Health Center, 1014 Broadway, Cincinnati 2, Ohio.

COLORADO RADIOLOGICAL SOCIETY

At a recent meeting of the Colorado Radiological Society the following officers were elected for 1953: *President:* Dr. Wendell P. Stampfli; *Vice-President*, Dr. Thomas Mahan; *Secretary*, Dr. William Curtis, 1612 Tremont, Denver Colo; *Treasurer*, Dr. Vernon Bolton.

MINNESOTA RADIOLOGICAL SOCIETY

The following new officers were elected by the Minnesota Radiological Society at a recent meeting: *President*, Dr. Malcolm B. Hanson, Minneapolis;

Vice-President, Dr. C. Allen Good, Rochester; *Secretary-Treasurer*, Dr. John R. Hodgson, Mayo Clinic, Rochester, Minn.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY

The officers of the Northeastern New York Radiological Society elected for the coming year are as follows: *President*, Dr. Joseph Rosenstein; *Vice-President*, Dr. I. J. Murnane; *Secretary-Treasurer*, Dr. John F. Roach, Albany Hospital, Albany, N. Y. The society will meet in the Albany area on the second Wednesdays of October, November, March and April. In addition, an annual meeting will be held in May or June 1953.

OHIO STATE RADIOLOGICAL SOCIETY

At the recent annual meeting of the Ohio State Radiological Society held at the Mansfield-Leland Hotel, Mansfield, Ohio, the following officers were elected for the coming year: *President*, Dr. Edward C. Elsey, Cincinnati; *Vice-President*, Dr. Austin J. Brogan, Dayton; *Secretary-Treasurer*, Dr. Willis S. Peck, 1838 Parkwood Avenue, Toledo 2, Ohio.

OREGON RADIOLOGICAL SOCIETY

At a recent meeting of the Oregon Radiological Society the following officers were elected for 1952–1953: *President*, Dr. Boyd Isenhart, Portland; *Vice-President*, Dr. Woodson Bennett, Salem; *Secretary-Treasurer*, Dr. J. Richard Raines, 214 Medical-Dental Building, Portland 5, Oregon.

RADIOLOGICAL SOCIETY OF NEW JERSEY

At the Spring meeting of the Radiological Society of New Jersey, the following officers were elected for the year 1952–1953: *President*, Dr. Peter Gianquinto; *Vice-President*, Dr. Vincent Whelan; *Secretary*, Dr. Nicholas G. Demy, 912 Park Avenue, Plainfield, N. J.; *Treasurer*, Dr. Salomon Silvera. The Fall meeting of the society will be held in early November.

WASHINGTON STATE RADIOLOGICAL SOCIETY

The officers of the Washington State Radiological Society for the year 1952–1953 are as follows: *President*, Dr. John W. Settle, Jr.; *Vice-President*, Dr. Richard Kiltz; *Secretary-Treasurer*, Dr. John N. Burkey, 555 Medical-Dental Building, Seattle 1, Wash. Meetings are held on the fourth Monday of each month from September through May.

INDIAN RADIOLOGICAL ASSOCIATION

At a recent meeting of the Indian Radiological Association Dr. K. M. Rai, M.B., B.S., F.R.C.S., (Eng.), D.M.R. (Lond.), Bernard Institute of Radiology, Government General Hospital, Madras, was elected President of the association for the year 1953. The Annual Congress of the Indian Radiological Association will be held in New Delhi, India, January 3 to 6, 1953. Dr. Elis Berven, Director of Radiumhemmet, Stockholm, Sweden, has consented to attend the Congress and will deliver the Third Sir Jagdish Memorial Lecture.

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. LEUCUTIA, M.D., Harper Hospital, Detroit 1, Michigan

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ROENTGEN DIAGNOSIS

HEAD

MACAULAY, DUNCAN. Digital markings in radiographs of the skull in children. *Brit. J. Radiol.*, Dec., 1951, *24*, 647–652.

The skull roentgenograms of 296 children up to the age of fourteen years in whom there was no intracranial disease were examined in detail. The digital markings were classified as faint, definite, or conspicuous, and each area of the skull was regarded separately. The average of the various areas was taken as the total rating of the skull.

It was found that the newborn skull usually presents few if any digital markings, but that there is a rapid increase in prominence up to the age of about four years. The digital markings remain fairly constant between the ages of four and nine years, and they decrease rather sharply in prominence after the age of ten. This curve of the incidence of digital markings parallels closely the curve of the rate of increase of the brain in weight for the same age groups. It was also noted that the range of the prominence of digital markings was rather small in any one age group, further suggesting that it is related to brain growth.

The author confirmed a previously made observation that the digital markings are less than average in individuals with hypoplastic brains, but this tendency is not sufficiently marked to be a reliable diagnostic criterion. The reverse of this is also true, and increased digital markings are not a reliable indication of increased intracranial pressure. The digital markings are probably an expression of the accommodation of two growing structures to each other.—*E. F. Lang, M.D.*

ESTRADA GONZÁLES, RAFAEL, GARCÍA PLASENCIA, M. A., INFANTE, EDUARDO, and CATÁ, GABRIEL. Pneumoencefalografía; técnica y resultados en cincuenta casos consecutivos. (Pneumoencephalography; technique and results in fifty consecutive cases.) *Arch. Hosp. Universitario*, Habana, Nov., Dec., 1951, *3*, 729–756.

Pneumoencephalography is indicated in epilepsy, suspicion of cortical atrophy, pachymeninigitis, etc., and is contraindicated in patients with increased intracranial pressure and tumors of the posterior fossa. In general, it is preferable to maintain relatively small differences in the amount of liquid withdrawn in comparison to air injected. Tolerance for the air injected apparently depends more on individual factors than on quantity of air injected. Apprehension and anticipation of pain were important. Patients with greater organic damage tolerated the procedure better. Usually 800 cc. of air was needed to fill the ventricular system. A film exposed after twenty-four hours was useful in confirming the diagnosis and in ruling out artefacts.—*Charles M. Nice, M.D.*

MALIS, LEONARD I., COHEN, IRA, and GROSS, SIDNEY W. Arnold-Chiari malformation. *Arch. Surg.*, Dec., 1951, *63*, 783–798.

Caudal displacement of brain stem, cerebellum and spinal cord (Arnold-Chiari malformation) is the most frequent of the developmental anomalies and malformations of the cervicomedullary junction.

Three cases with Arnold-Chiari malformation are presented. In all 3 cases, the diagnosis was suggested clinically and substantiated myelographically. The patients were successfully treated by surgery.

The malformation consists essentially of a cerebellar abnormality in which the obvious feature is the presence of two tongue-like extensions of abnormal cerebellar tissue along the dorsal surface of the cervical neuraxis. These are referred to as cerebellar tonsils. The cerebellum is grossly abnormal and no vermis is present.

When the cerebellar abnormality exists with little displacement of the medulla oblongata, it is called the Arnold deformity. More frequently, the medulla lies anterior to the malpositioned tongues of the cerebellar tissue and, thus, caudal to the foramen magnum. The shift of the medulla is the Chiari malformation. Any degree of chronic arachnoid adhesions may form here, producing a block of the foramina of Luschka or Magendie or producing a perimedullary subarachnoid block.

The displaced structures are subject to vascular impairment, perhaps with cystic degeneration. There may occur a rupture or dilatation of the central canal due to obstruction of the fourth ventricle.

The so-called medullary nodule is frequently described as lying just caudal to the extension of the cerebellar tongues. The fourth ventricle lies within the nodule. The upward inclination of the intrathecal course of the cervical nerve roots is the result of caudal displacement of the cervical portion of the spinal cord.

The authors feel that the malformation is a primary anomaly of the hindbrain, rather than the secondary result of mechanical factors.

Symptoms in 40 cases of Arnold-Chiari malformations are discussed. They were: motor or reflex changes in extremities; nystagmus; headache; cerebellar dysfunction; sensory loss; diplopia; dysfunction of cranial nerves IX, X, XI and XII; papilledema; vomiting and tinnitus or deafness. The motor or reflex changes in the extremities were the most common and tinnitus and deafness the least common.

Roentgenologically platybasia was the most frequent finding, being present in 20 cases. A definite diagnosis can be made myelographically.

The surgical treatment consists of moderate suboccipital craniectomy and upper cervical laminectomy.—*C. P. Truog, M.D.*

Verbiest, M.-H. L'anéurisme artérioveineux intradural. (Intradural arteriovenous aneurysm.) *Rev. neurol.*, 1951, *85*, 189–199.

After reviewing the salient features of intradural arteriovenous aneurysm as recorded in the literature on the subject, the author reports 2 of his own cases in detail.

In the first case, symptoms began to develop after a severe head trauma. The diagnosis of arteriovenous fistula was made on the basis of a bruit heard over the right side of the skull, the development of arterial hypertension with left ventricular preponderance, and the result of catheterization of the internal jugular veins, while roentgen examination, including angiography and ventriculography, failed to disclose any definite lesion. The clinical diagnosis was confirmed surgically and at autopsy.

The second patient had a pulsating mass of the scalp, without symptoms suggestive of intracranial disease. Roentgenograms showed unilateral widening of the groove of the middle meningeal artery, and cerebral angiograms disclosed dilatation of this artery, with numerous communications between the posterior temporal artery and the venous system in the posterior part of the skull. The diagnosis was confirmed surgically, and the patient recovered.

The author concludes that cerebral angiography may not reveal the presence of intradural arteriovenous fistulas, while certain clinical findings seem to be relevant. These are: the difference between systolic and diastolic blood pressure is greater in the lower than in the upper extremities; systolic pressure is higher in the arm on the side opposite the intracranial lesion; and there are the other general signs of arteriovenous fistulas, such as elevated blood pressure, left ventricular enlargement, and increased pulse pressure. The author notes that, even in the absence of clinical symptoms, cortical atrophy may be present as the result of the pressure changes which the fistula induces.—*Albert Oppenheimer, M.D.*

Fincher, Edgar F. Spontaneous subarachnoid hemorrhage in intradural tumors of the lumbar sac; a clinical syndrome. *J. Neurosurg.*, Nov., 1951, *8*, 576–584.

This is a neurosurgical postulate in which there is an abrupt onset of intractable sciatica, a concomitant violent headache and the presence of a liberal amount of fresh blood in the spinal fluid.

A group of 5 cases are reported in detail. Each patient had recurrent attacks of pain with blood in the spinal fluid with little evident nerve damage at the onset to localize the lesion.

The tumors were removed and found to be 3 ependymomas, 1 neurofibroma and 1 neuroglioma.

It is suggested that early studies be performed in any patient presenting this syndrome.—*V. L. Peterson, M.D.*

Hubble, Douglas. Hypopituitarism in first cousins. *Arch. Dis. Childhood*, Dec., 1951, *26*, 530–538.

Two male first cousins are described in one of whom, aged seven and a half years, pituitary dwarfism was present and in the other, aged twenty, pituitary hypogonadism, with deficient urinary excretion of gonadotropins, testicular hypoplasia, eunuchoid habitus, defective secondary male sexual characters, osteoporosis with retarded union of epiphyses could be demonstrated.

Criteria are suggested for the clinical diagnosis of pituitary dwarfism of which the most important are the persistence of an immature facies, the retardation of bone age by at least two years and a height which is at least 20 per cent below the average for coevals in the proved absence of hypothyroidism.

It is suggested that when other treatments have failed it is justifiable to use methyl-testosterone therapy after the age of puberty in pituitary hypogonadism, and before the age of puberty in pituitary dwarfism. In the latter case, care must be exercised not to advance the child's bone age beyond the chronological age so that early epiphyseal closure is avoided.—*J. J. McCort, M.D.*

Bonnal, J., and Santamaria, F. L'angiographie carotidienne (notes à propos du diagnostic topographique et histologique des tumeurs cérébrales). (Carotid angiography; remarks on the topographic and histologic diagnosis of cerebral tumors.) *J. de radiol. et d'électrol. & Arch. d'électric. méd.*, 1952, *33*, 136–146.

The authors performed 260 carotid angiographic examinations, 57 of which were done for the localization of brain tumors. Based on this material and an extensive review of the Portuguese, Scandinavian and German literature, they discuss at length (1) the indications of the method, (2) its technique, dangers and contraindications and (3) its value for the topographic and histopathologic diagnosis of brain tumors.

(1) The indications are: vascular anomalies (aneurysms, angiomas), thrombosis of the internal carotid artery, extradural and, in particular, subdural hematomas, brain abscess and especially brain tumors.

(2) Of the many contrast media tried, the most innocuous appears to be an iodized compound (marketed in 35 per cent and 50 per cent solutions) which is known under the name of umbradil in the Scandinavian countries, diodrast in the Anglo-Saxon countries and diodone in France. Although the three preparations produce identical opacification, there is some difference in the degree of their toxicity. Broman and Olsson, by studying the prob-

lem experimentally in rats, found that 35 per cent umbradil and 35 per cent umbradil methylglucamine are the only substances devoid of an effect on the vessel wall. For this reason, the authors more recently switched from the 35 per cent and 50 per cent diodone (Guerbet) to the 35 per cent and 50 per cent umbradil (Astra Borne) which they use in a mixture of two-thirds of the 50 per cent and one-third of the 35 per cent solution.

The injection is made percutaneously into the common carotid artery. To avoid repeated puncture of the vessel wall, possibly leading to post-arteriographic emboli, a Y-shaped tube is used, one arm of which is connected to a saline system (to which is added procaine hydrochloride to prevent spasm) and the other to a syringe containing the opaque substance. By changing the position of the stop-cock either the saline solution or the opaque substance may be allowed to flow into the injecting needle. In exceptional cases, the injection is made directly into the external carotid or internal carotid arteries. Usually 10 cc. of the opaque substance is injected in two seconds, through a needle 1 to 1.2 mm. in caliber, the pressure being controlled manually. Angiograms in the posteroanterior and lateral views are taken routinely, the first exposure being made after injection of 8 cc. of the opaque medium and the others at intervals of one and a half seconds thereafter. The authors believe that simultaneous bilateral injections are superfluous; instead they prefer the injection twice of 10 cc. each on the same side, with further increase of the amount in the presence of vascular anomalies, especially arteriovenous aneurysms.

Contraindications are: idiosyncrasy (preliminary iodine sensitivity test should be carried out routinely), hypertension exceeding 240 and advanced age above sixty-five. Occasionally, untoward effects are noted, consisting of transient hemiplegia, epileptic seizures and, in the case of brain tumors, temporary edema leading to aggravation of the symptoms due to increased intracranial pressure.

(3) The most important signs of localization of brain tumor are the displacement of the normal vessels and the demonstration of formation of new vessels, the configuration of which may also permit certain deductions as to the histopathologic nature of the tumor. The displacement of the vessels depends on the size, location and type (infiltrating, cystic or circumscribed solid) of the tumor and on the presence of peritumoral edema or concomitant hydrocephalus. The formation of new vessels unfortunately is demonstrated in only about half of the cases; however, when present, it aids the diagnosis considerably by rendering visible the tumor area.

The authors prefer the following topographic classification of brain tumors: (a) frontal, (b) rolandoparietal, (c) temporal, (d) occipital and (e) central. The angiographic findings in these tumors are described in detail and illustrated with reproductions of representative roentgenograms.

Certain information can be obtained as to the histopathologic nature of the tumor in (a) glioblastoma multiforme, (b) meningioma, (c) metastatic tumors and occasionally in (d) a few rarer tumors (angiosarcoma, oligodendroglioma, cholesteatoma, etc.).

The conclusion is reached that carotid angiography, although not infallible, is of greater aid than ventriculography in the diagnosis of hemispheric tumors especially when they are located superficially near large vessels. Ventriculography continues to remain the method of choice in deep-seated midline tumors of the third and fourth ventricles and may also be useful in those instances in which angiography fails to furnish the desired information. Thus the two methods complement each other but it must be emphasized that angiography is the more innocuous of the two.—*T. Leucutia, M.D.*

CAUGHEY, J. E. Radiological changes in the skull in dystrophia myotonica. *Brit. M. J.*, Jan. 19, 1952, *1*, 137–139.

Thirteen cases of dystrophia myotonica are reported briefly. All these cases presented roentgenological abnormalities of the skull. The most constant changes were: a small to very small pituitary fossa, thickening of the calvarium, and hyperostosis interna. There was enlargement of the sinuses in some and in two the mandible was elongated. The authors feel that the high incidence of these changes cannot be coincidental and that they should be accepted as some of the variable features of dystrophia myotonica.—*William A. Klauber, Jr., M.D.*

STAFNE, EDWARD C. Dental roentgenologic manifestations of systemic disease. I. Endocrine disturbances. *Radiology*, Jan., 1952, *58*, 9–22.

This is the first of a series of articles concerning the roentgenologic changes in the bones of the jaw and teeth as manifestations of systemic disease. The current article is a short discussion of the alterations due to pituitary, thyroid, parathyroid, adrenal, and gonadal hormones. Any hormonal quantitative change may disturb both the growth and metabolism of bone. Dental effects may remain permanently. To affect the teeth, the changes must almost entirely occur during the developmental period. They are produced by retardation or acceleration of development and eruption, or by faulty and imperfect structural development.

In general, tooth size is not affected by endocrine disturbances. Teeth in which calcification has been completed prior to the onset of the disturbance are not affected; there is no change in mineralization or in roentgenographic density. The jaw bone changes are similar to those of other bones. Tooth development generally parallels skeletal age development.

Hypopituitarism: With the onset in infancy, growth of the jaw is retarded and underdeveloped

along with the rest of the skeleton. The size of the teeth is not affected, but their growth and development are retarded.

Giantism: If the onset of hypersecretion occurs before five or six years of age, there is symmetrical overgrowth of the body parts. The mandible may grow disproportionately large. The dental roentgenograms show a normal trabecular pattern, no appreciable increase in the roentgenographic density of the bone, and abnormal spacing of the anterior teeth (especially in the mandible). The roots of the posterior teeth are large in proportion to the size of the crown.

Acromegaly: The cellular activity is greater at the sites of endochondral bone formation. There is great increase in the length of the ramus of the mandible as a result of the endochondral bone formation of the condyle, which leads to supra-eruption of the teeth. This is followed by an apposition of bone at the alveolar crest which increases the height of the mandibular body and results in marked enlargement and decided prognathism. There is increased roentgenographic density and the trabecular pattern is normal.

Hypothyroidism: This must occur in early childhood to affect the jaws and teeth. Small and underdeveloped jaws occur along with retarded shedding of the primary teeth and delayed eruption of the permanent teeth. The size and form of the teeth are not affected. The response is usually favorable to adequate thyroid therapy.

Hyperthyroidism: If the onset is in childhood, there is accelerated skeletal growth, including development and eruption of the teeth. There may be an associated osteoporosis, which is not sufficient to be of diagnostic value.

Hypoparathyroidism: If the onset is in early life, there is a hypocalcemia causing hypoplasia of the enamel and possibly of the dentin. The eruption and maturation of the teeth are retarded. There may also be calcification in the cerebral basal ganglia.

Hyperparathyroidism: There is decreased roentgenographic density and the normal trabecular pattern becomes lace-like. In advanced cases, the trabeculations may be absent or exhibit a cyst-like appearance and when such areas are more circumscribed, actual giant cell tumor formation may be present. The lamina dura may be partially or completely absent; and the teeth, in which there is no alteration in roentgenographic density, stand out in marked contrast to the radiolucent osteoporotic bone. With the disappearance of the lamina dura, the roots of the teeth appear to be spindle-shaped and present a picture similar to that of the root of an extracted tooth. The cementum which covers the root is not as radiopaque as dentin, and when the lamina dura, which represents the tooth socket, disappears, and there is decreased roentgenographic density of the surrounding bone, the cementum becomes less distinct. In successful treatment, the lamina dura is restored, giving a normal root appearance.

A characteristic feature is the disappearance of the narrow radiopaque lines which represent the borders of the maxillary sinuses, nasal fossae, and the alveolar crest of the maxilla; the disappearance of the wider radiopaque line which normally represents the cortical bone on the alveolar crest and inferior border of the mandible also occurs.

Polyostotic fibrous dysplasia: Albright's syndrome: When the jaws are involved, the lamina dura is absent only in the regions of the lesions, which are usually osteoporotic.

Androgenital syndrome: When hypersecretion develops early in childhood, there is accelerated dental development to a varied degree but not to such a degree as skeletal development. In the primary hypogonadism in which there are delayed maturation and an overgrowth of bones, and in the hypergonadism in which there is early and accelerated maturation of the skeleton, there also may be an early and accelerated development and eruption of the teeth.

Cushing's syndrome: There is an associated osteoporosis (64 per cent females and 75 per cent males), most commonly occurring in the vertebrae, ribs, and pelvis. The incidence in the jaw is not known. One patient revealed a uniform osteoporosis of the maxilla and mandible, with partial obliteration of the cortices, the lamina dura, and the radiopaque lines which define the borders of the maxillary sinuses, but not the marked change in the trabecular pattern seen in hyperparathyroidism.

Hypoinsulinism (diabetes mellitus): Periodontosis is almost pathognomonic, although it rarely occurs in children. There may be rapid and marked destruction of the alveolar bone in uncontrolled diabetes. Such lesions may be limited to one or a few regions, or may be generalized and involve all the teeth. The tooth root may lose all osseous support, with consequent sloughing out of the tooth.

Progeria (Hutchinson-Gilford syndrome): This disease usually manifests itself at about one year of age in a healthy patient. There is prolonged retention of the primary teeth with little evidence of tooth root resorption. Unerupted teeth are of normal size, are overcrowded and malposed in very small underdeveloped jaws. Dental development is slightly retarded and the eruption age is about four years late. —*Dean Nichols, M.D.*

Neck and Chest

Ardran, G. M., and Kemp, F. H. The mechanism of swallowing. *Proc. Roy. Soc. Med.*, Dec., 1951, *44*, 1038–1040.

The mechanism of swallowing was investigated by cinematography of the fluorescent screen image of individuals swallowing barium paste with or without admixed food. In one case a silver clip was affixed to the epiglottis and films obtained; 25 to 50 frames were exposed per second during the filming.

Swallowing commences with the tongue pressing upwards and forwards against the hard palate so that the food bolus is squeezed posteriorly. As the bolus passes through the fauces, the arched dorsal surface of the tongue is lowered to form a steep slope leading down into the valleculae. Meanwhile the oropharynx has been narrowed and the opening of the nasal pharynx closed off.

When the apex of the bolus reaches the valleculae the epiglottis tips backwards against the posterior pharyngeal wall. The bolus is arrested momentarily, but some of it soon spills over the pharyngo-epiglottic folds into the lateral food channels. As the main mass of the bolus is thrust backwards, the slope of the tongue is progressively increased, becoming vertical as the last of the bolus enters the pharynx. Regurgitation into the mouth is blocked by the mass of the tongue and the opposed anterior pillars of the fauces.

Associated with movement of the tongue, there is progressive elevation of the larynx and hyoid bone which results in constriction of the lumen of the larynx. As the mass of the bolus enters the pharynx, the larynx is pulled forward so that the epiglottis comes away from the posterior pharyngeal wall and stands out like "a rock under a waterfall." The larynx, although narrowed, is not always closed. Most of the food is diverted down the lateral food channels but some passes directly over the larynx and little often enters the laryngeal vestibule.

The second stage of swallowing is concluded when the tongue arches backward into the pharynx and the posterior pharyngeal wall is pulled forward to meet it. This action occurs from above downward with resultant progression of the bolus down the esophagus. The tongue of the epiglottis is tipped backward and appears to be "swallowed." Meanwhile the larynx, which is still raised, is bent backwards so that the tip of the epiglottis reaches down into the mouth of the esophagus.

Many records obtained at this phase of swallowing indicate that the lumen of the larynx is greatly narrowed but permits air to be drawn into the esophagus after the manner of a water suction pump. Finally, the lumen of the larynx is closed. After the last of the bolus has moved into the esophagus, the tip of the epiglottis is brought forward over the larynx and there is a pause while the bolus travels down the esophagus. Reinflation of the airway then takes place. The larynx appears to fill with air from below as it falls back to its normal position of rest and the epiglottis assumes its erect position. The pharnyx fills with air from above as the soft palate descends. When the airway has thus been restored the subject takes a breath and resumes ordinary respiratory movements.

Anteroposterior projections of the oral and pharyngeal structures are difficult to obtain because of the superimposed skull. The main features show that as the bolus is thrust upward it is compressed from above downward and from side to side. It descends into the pharynx in the midline of the tongue which becomes a furrow. As the bolus stream reaches the epiglottis, it is divided by the glosso-epiglottic fold and is diverted into the valleculae. After a momentary pause it spills over one or both pharyngo-epiglottic folds into the lateral food channels and quickly passes into the esophagus. If both lateral food channels are used, the two streams become confluent about the level of the opening of the esophagus. When fluid is swallowed, the esophageal stream may be canalized by a column of air, apparently aspirated from the larynx.—*D. R. Bernhardt, M.D.*

BOCCA, ETTORE, and MALOSSINI, EMILLIO. A propos des «diverticules fonctionnels» de l'œsophage thoracique. (Concerning "functional diverticula" of the thoracic esophagus.) *Ann. d'oto-laryng.*, 1951, *68*, 806–819.

Gregoire (1926) and Bársony and Polgár (1927) described the roentgenologic picture of diverticular formations of the esophagus, having the characteristic of appearing and disappearing at different levels of the esophageal phase of deglutition. They called the formations in question "functional diverticula of the esophagus." There are no nearby lesions of the mediastinum as seen in traction diverticula, and esophagoscopy reveals no lesion that is demonstrable. Clinical symptoms are absent or slight. The diverticular area contracts and barium is not retained.

The authors believe that esophageal dyskinesia is the underlying factor, analogous to colonic dyskinesia in the picture of pseudodiverticula of the colon and, in fact, these patients may exhibit segmental spastic changes in the stomach or colon. An area of relative spasticity is found in the esophagus beneath the functional diverticula, and the diverticula recede with regression of this spasm, whether spontaneous or provoked by antispasmodics such as amyl nitrite. One might, then, term these formations "spastic dyskinesia of the esophagus (pseudodiverticula)." —*Charles M. Nice, M.D.*

LEIGH, TED F., ABBOTT, OSLER A., and HOPKINS, WILLIAM A. Roentgenologic considerations in tracheo-esophageal fistula without esophageal atresia; with report of two cases. *Radiology*, Dec., 1951, *57*, 871–877.

A brief résumé is given of the few cases of tracheo-esophageal fistula without esophageal atresia which are reported in the literature.

The authors present the symptoms, roentgen studies and treatment of 2 additional cases which they diagnosed by roentgen investigation.

For a successful roentgen demonstration of a tracheo-esophageal fistula without atresia, they make the following suggestions:

1. Optimum positioning of the patient. This is usually the right anterior oblique position, in relation to the table top viewed in the prone position.

2. Correct positioning of the esophageal tube. Usually the tip of the esophageal tube should be cephalad to the level of the carina.

3. Proper selection of contrast material. Barium should never be used. Either iodized oil or 35 per cent solution of diodrast is preferred.

4. Proper interpretation of findings. This is discussed in detail.

Illustrations demonstrate the relationship of the trachea, esophagus and fistula.—*E. E. Seedorf, M.D.*

Burnett, Jack M., and St. John, Elmer. Primary melanosarcoma of the esophagus. *Radiology*, Dec., 1951, *57*, 868–870.

The clinical history of a primary melanosarcoma of the esophagus is given. A spot film of the esophagus showing the obstructing mass and photomicrographs are included. The rare occurrence of either primary or metastatic melanosarcoma of the esophagus is stressed.—*E. E. Seedorf, M.D.*

Wu, Y. K., and Loucks, H. H. Carcinoma of the esophagus or cardia of the stomach; an analysis of 172 cases with 81 resections. *Ann. Surg.*, Dec., 1951, *134*, 946–956.

Resections of esophageal malignancy in 12 patients in 1940 and 1941 led to 2 survivals beyond five years. The authors' new series extended over a three and one-half year period ending May 31, 1950, and included 172 patients observed in North China.

Suspected etiological factors were thermal irritation, rough and irritant food and strongly alcoholic drinks. A positive family history for carcinoma of the esophagus was present in 22 per cent of the patients. The incidence of habitual use of the strong native distillate pai kan (alcohol content 60–85 per cent) was 50 per cent among the patients compared to an incidence of 12 per cent among patients of similar age hospitalized for other conditions. The sex distribution was 158 males and 14 females.

The location of the lesion varied as follows:

Above the aortic arch	6
Aortic arch to inferior pulmonary vein	81
Below inferior pulmonary vein	45
Cardio-esophageal junction and cardia	40
	172

The resectability rate has been 63.3 per cent of all patients explored and the operative mortality for 26 resections performed during the year 1949 has been 7.7 per cent, these figures being similar to those of Sweet, Garlock, Strieder and others.

Forty-one of 67 patients who survived resection are living from a few months to more than three years after operation.

The authors offer a plea that medical thought be changed to search for the patient who has early symptoms of esophageal or esophagogastric malignancy rather than waiting for the classical symptoms of constant dysphagia and emaciation. They believe the most important early symptoms are:

1. Occasional choking on food.
2. Transient intervals of dysphagia.
3. Vague substernal pain.
4. Substernal pressure.

Only by awareness of these early and inconstant symptoms will resections be done sooner for better end-results.—*J. W. Turner, M.D.*

Salmon, H. W., and Meynell, G. G. Primary hyperparathyroidism (adenoma) simulating sarcoidosis; report of a case. *Brit. M. J.*, Dec. 15, 1951, *2*, 1440–1442.

Although both primary hyperparathyroidism and sarcoidosis are uncommon disorders of different etiology, there may be a close resemblance between their clinical manifestations. For example, the authors report the case of a thirty-three year old woman, four months postpartum, who stated that for several years, she had been troubled by nocturnal pains in her limbs and back, that her pains had become severe, and that recently she had lost weight and suffered from headache and swelling of the ankles. Roentgenograms revealed heavy hilar shadows, pulmonary fibrosis with peripheral reticulation, generalized skeletal demineralization, and cystic defects in the phalanges of the right hand (the left hand was congenitally absent). The pulmonary and skeletal changes were interpreted as suggestive of sarcoidosis. The blood calcium was elevated, the serum proteins were low and the A/G ratio was normal. Also the blood urea was elevated, renal function was impaired, and there were numerous calcifications in the kidneys. The right lobe of the thyroid was slightly prominent. At exploration, a large parathyroid adenoma was found displacing it.

The authors conclude that hyperparathyroidism with metastatic calcification of the lungs should be considered when a suspected diagnosis of sarcoidosis is not confirmed by tissue biopsy.

The differential value of serum protein determination is considerable. In hyperparathyroidism, the A/G ratio is normal and the serum protein normal or low; in sarcoidosis, the A/G ratio is inverted during an active phase of the disease and the serum protein is elevated.—*George Cooper, Jr., M.D.*

Fischer, F. K. Die Phlebographie von Schulter, Hals und Mediastinum. (Phlebography of the shoulder, neck and mediastinal regions.) *Schweiz. med. Wchnschr.*, Dec. 8, 1951, *81*, 1198–1205.

Fischer, working in the Roentgen Diagnostic De-

partment in the University of Zurich under the direction of Professor H. R. Schinz, has developed a new technique and procedure of phlebography with the particular purpose of better delineating the veins of the shoulder, neck and mediastinum—the tributaries of the superior vena cava.

His technique is a variation of the usual procedures of angiocardiography. A sturdy needle, 1 mm. in diameter, is used for the veni puncture. Percutaneous injection is usually made into the cephalic or basilic vein without exposing the vein. The contrast medium is 70 per cent ioduron. From 40 to 80 cc. is injected within one to three seconds in every case. In order to get a rapid and efficient injection, a specially devised pressure apparatus is used, creating a force of about 20 to 60 kilograms. The pressure apparatus, which is well illustrated in the article, has a long lever with a 5 to 1 ratio for exerting pressure against the piston of the specially built syringe. Because of the extra pressures exerted, the piston must have a special gasket which is also pictured in the article. With this more rapid injection, one gets a better filling of the tributaries of the vena cava. Because of the great pressure used, the material is actually sprayed into the blood stream, rather than put in by a fine stream.

Indications for the procedure are any suggestion of stasis in the vessels, the cause for which is not apparent on conventional roentgenograms. The author has used it in tricuspid insufficiency as well as other conditions where there was increased venous pressure or a tamponade of the heart.

Other causes for compression of these structures that have been studied include tumors of the mediastinum (benign and malignant), aneurysm, lymphadenitis, mediastinitis and thrombosis of any of the tributaries of the vena cava.

Additional information about the operability of lung cancer has been obtained by this method.

The article is well illustrated.—*P. C. Swenson, M.D.*

Sreenivasan, B. R. Broncho-pulmonary segments. *Proc. Alum. Ass. King Edward VII Coll. Med.*, Singapore, Sept., 1951, *4*, 181–189.

A bronchopulmonary segment may be defined as the portion of lung served by a principal branch of a lobar bronchus, and this branch may then be called a segmental bronchus. A bronchopulmonary segment is a separate anatomical and physiological unit and, from the point of view of the surgeon, it can be removed by itself.

Pathology. There are two main pathological considerations namely, collapse and consolidation. They are due to obstruction and inflammation.

I *Obstruction* of the bronchus may be due to:—
- (a) Causes outside the wall
  - (1) Tuberculous lymph nodes, Hodgkin's disease, malignant lymph nodes, sarcoidosis
  - (2) Aneurysm of the aorta (compression of the left bronchus)
  - (3) Cardiac dilatation (chiefly aneurysmal dilation of the left auricle)
- (b) Causes in the wall: adenoma, carcinoma
- (c) Causes within the lumen
  - (1) Secretions (from the common cold, respiratory tract infections, pertussis)
  - (2) Blood resulting from hemoptysis
  - (3) Tuberculous tracheobronchitis
  - (4) Foreign bodies

II. *Inflammation* is the result of infection and leads to consolidation. Although collapse and consolidation are regarded as distinct entities in practice, the two overlap. All gradations can occur between the two extremes of pure collapse and pure consolidation.

Partial obstruction of a bronchus leads to emphysema of the area supplied by the bronchus; complete obstruction leads to absorption collapse. Atelectasis is not a proper term for this type of collapse since etymologically it signifies an inability of the lung to expand at birth and should be limited to that situation. The mechanism of collapse is usually explained by absorption of air in the involved area with contraction due to elastic recoil of the lung. To establish the diagnosis both posteroanterior and lateral roentgenograms are imperative. It is now the practice of chest hospitals in England to routinely take posteroanterior and lateral chest roentgenograms. Interpretation should never be attempted without recourse to both views. Bronchograms are most useful in confirming the presence of a segmental lesion. Obstruction, crowding of the bronchial tree, bronchial dilatation, and splaying of other bronchial segmental branches are easily demonstrated.

Bronchiectasis. The old view that the etiological factor is infection with traction on the bronchial walls from subsequent fibrosis is being discarded. Infection and fibrotic traction are now considered late sequels, not the cause. The primary cause is segmental or lobar collapse due to a mucous plug obstruction. In the case of lobar obstruction, absorption collapse of the entire lobe follows. Due to negative pressure in the whole lobe, the plug of mucus is split and sucked into the smaller bronchi. The negative pressure exercises traction on the walls of the now patent bronchus above the obstruction causing dilatation because the patent bronchus is surrounded by airless lung. Infection supervenes, helping make the dilatation permanent or irreversible. If bronchi containing cartilage are affected, the bronchiectasis is cylindrical; if noncartilaginous bronchi are involved, the result is saccular bronchiectasis. If infection does not supervene, the process remains reversible possibly for a period of one or two years. Lung abscess results when infection is

massive, virulent and immediate, and usually develops in a matter of days or weeks whereas in bronchiectasis the process develops over months or years. Abscess is often limited to a bronchopulmonary segment and is then surgically curable. The postural treatment of bronchiectasis depends on the position of the segment involved, which can be determined accurately only by bronchography.

Cancer of the Lung. Early recognition in the central type depends on segmental analysis. Partial occlusion, emphysema and segmental collapse is the usual sequence. Early and complete bronchography is indicated by any of these findings.

Significance of Bronchial Occlusion in Pulmonary Tuberculosis. Pressure of enlarged tuberculous lymph nodes can cause segmental collapse which is often wrongly interpreted as post-primary tuberculosis. With the use of streptomycin in bronchial tuberculosis, ulcers heal and cause fibrosis resulting in occlusion with segmental or lobar collapse. Tuberculous cavities may be "blown out" due to a little secretion blocking the bronchus—the lung supplied by this bronchus becomes airless, the plug of mucus is sucked farther down, some air now enters the cavity and the negative pressure exerted by the area of collapsed lung on the walls of the bronchus causes expansion of the cavity.

Pneumonias. Localized lung shadows not corresponding to tuberculosis and not accompanied by the typical clinical picture of pneumonia are often found to be segmental or lobar, and may be caused by influenza or virus infections, *Rickettsia* infections, or aspiration of secretions.—*Chauncey N. Borman, M.D.*

Cocchi, Umberto. Die Lungensegmente und die Segmentpneumonien. (The segments of the lung and the pneumonias of the segments.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Dec., 1951, *75*, 57–72.

The interest in the detailed anatomical as well as roentgenological study of the pulmonary lobes and their subdivisions has increased markedly with the recent advances in pulmonary surgery and with the refinement of bronchoscopic and bronchographic techniques. It is therefore not sufficient any longer to subdivide the lung into upper, middle and lower lobes, for it is well known that pulmonary diseases such as atelectasis or other changes usually do not involve an entire lobe but only certain segments of it. The segments are known to be related to the distribution of the bronchial tree.

It is particularly important to recognize these facts and to localize exactly the various pulmonary diseases when removal of benign lesions is contemplated and when normal lung tissue can be spared. It is understandable that several attempts have been made to promote a uniform nomenclature.

The following nomenclature for the subdivision of the bronchial tree has been agreed upon in London and is recommended:

Right Upper Lobe: 1, apical, 2, posterior, 3, anterior bronchial segment;
Left Upper Lobe: 1, and 2, apicoposterior, 3, anterior, 4, superior lingular, 5, inferior lingular segment;
Right Middle Lobe: 4, lateral, 5 medial bronchial segment;
Both Lower Lobes: 6, apical, 7, cardiac (only on the right side), 8, anteriobasal, 9, laterobasal, 10, posterobasal bronchial segment.

This nomenclature seems to be sufficient for all practical purposes even considering the numerous variations. It can be hoped, therefore, that the confusion of names will be eliminated by its use.

It is questionable whether a separate axillary upper lobe segment exists. The not infrequent occurrence of isolated pathological processes in the axillary pulmonary area favors the presence of such a segment. A separate axillary bronchus, however, is probably not present at all times. The statistical reports vary on this from 12 to 70 per cent.

It is necessary to have two films available, one dorsoventral and one lateral, in order to determine the exact location of a pulmonary process. Often only one segment is involved. However, it is not rare to see two or three neighboring segments involved in the same condition.

The author describes at length the roentgenological changes noted in the involvement of each individual bronchial segment and the various combinations of them. His description is accompanied by sketches and roentgenographic and bronchoscopic illustrations.

The involvement of one or several pulmonary segments is not rare and must be differentiated from pleural or interlobar disease. It must not be forgotten, however, that numerous variations in the distribution of the bronchial tree exist and that such variations may lead to entirely different roentgenological aspects. Chronic collapse of a lobe may also alter the normal location and appearance of a segment. It is often impossible under such conditions to localize a bronchial segment unless bronchographic studies are employed.—*H. P. Mueller, M.D.*

Elkin, Milton, and Sosman, Merrill C. The Harvard Public-health Chest Clinic. *New England J. Med.*, Dec. 13, 1951, *245*, 930–933.

The importance of routine roentgenographic examination of the chest, especially in pulmonary disease, is stressed.

For this study, the usual 70 mm. photofluorograms were taken with the films being interpreted by a radiologist of specialty board level.

Of 30,519 examinations from September 29, 1947,

to July 1, 1950, 513 (1.5 per cent) suggested active pulmonary tuberculosis. Of the 513 cases, 454 were followed adequately with 72 of the latter (0.24 per cent of the total) proving to be cases of active tuberculosis. Forty-seven per cent of the 72 cases were minimal. Among the cases were 20 hospital employees, 15 gravidae and 3 medical students.—*L. A. Pilla, M.D.*

CHRISTIE, ARTHUR C. Report on mass radiology of the chest in the United States. *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Dec., 1951, *75*, 50–56.

While case finding has been recognized for many years as a method of primary importance in tuberculosis control and the roentgen examination of the chest has held an undisputed first place, the use of this method for a long time was restricted because of its cost. The photofluorographic examination began in the United States after the work of de Abreu in Brazil when Lindberg of Illinois and I. Seth Hirsch of New York publicized it.

The official agencies of tuberculosis control are the state health departments, and the Tuberculosis Control Division of the Public Health Service of the Federal Government. The most important of the nonofficial organizations is the National Tuberculosis Association.

The original objective in 1946 was to secure photofluorographic films of the entire population above fifteen years of age within a period of five years. From 1946 to 1949 inclusive 42 million people have had fluorographic examinations of the chest.

The author stresses the fact that one-half of all cases of significant tuberculosis have very slight or no symptoms. The objectives of the U. S. Public Health Service for tuberculosis control have been stated as follows: "(1) The discovery of every person in this country infected with tuberculosis, (2) isolation and medical care for every patient needing treatment, (3) after care and rehabilitation, and (4) protection of the afflicted family against economic distress."—*Joseph N. Ané, M.D.*

WOODRUFF, C. EUGENE, and NAHAS, HECTOR C. Pulmonary tuberculosis, bronchiectasis, and calcification as related to bronchogenic carcinoma. *Am. Rev. Tuberc.*, Dec., 1951, *64*, 620–629.

An analysis of the postmortem findings and roentgenograms in 1,144 autopsies performed at the William H. Maybury Sanatorium (Detroit Tuberculosis Sanatorium), Northville, Michigan, indicates a relationship between previous tuberculous infection and primary squamous cell carcinoma of the lung.

Twenty-three primary carcinomas of the lung were re-evaluated from this material. There were 12 cases of squamous cell carcinoma, 9 cases of undifferentiated carcinoma and 2 cases of adenocarcinoma. The criteria of previous tuberculous involvement were either a healed calcified focus or calcified draining tracheobronchial lymph nodes.

In each case of squamous cell carcinoma the lesion involved an upper lobe and with but one exception there was evidence of post-pulmonary tuberculosis. The suggested explanation is the frequency of bronchiectasis as a residuum of healed tuberculosis. The columnar epithelium normally lining a bronchus is often replaced by stratified squamous epithelium in bronchiectatic bronchi. Possibly under constant irritation epithelial metaplasia results in squamous cell carcinoma. One suggested irritant is the tar residue of cigarette smoke. The incidence of upper lobe lesions is related to the frequency of saccular bronchiectasis in the upper lobes and tubular bronchiectasis in the lower lobes.

In the 11 other primary carcinomas the lesions were predominantly lower lobe and in only 3 cases were the criteria of previous tuberculous involvement fulfilled.—*E. E. Julien, M.D.*

USATEGUI, AUGUSTO, and ANTONETTI MUÑIZ, CARLOS. La obstrucción bronquial en tuberculosis. (Bronchial obstruction in tuberculosis.) *Arch. Hosp. Universitario*, Habana, Nov., Dec., 1951, *3*, 631–684.

Small bronchi, not visible at bronchoscopy, play an important part in the development, evolution and healing of tuberculous lesions. Gross anatomic, histologic and physiologic aspects of the lung in health and disease are considered. Obstructive bronchial lesions are given special consideration. In tuberculous infiltrations bronchial drainage is inhibited. With further involvement of the bronchial wall, various stages of emphysema, atelectasis and continued hindrance of bronchial drainage is noted. Drainage of tuberculous cavities may lead to amelioration of general clinical symptoms, results in recovery of bacilli from sputum, and may allow spread to other pulmonic areas. Bronchial valvular action may prevent collapse of cavities. Streptomycin, by exerting a healing effect on bronchial lesions, may allow collapse of cavities, or may allow healing by filling in and fibrosis.—*Charles M. Nice, M.D.*

COHEN, ABRAHAM G. Atelectasis of the right middle lobe resulting from perforation of tuberculous lymph nodes into bronchi in adults. *Ann. Int. Med.*, Oct., 1951, *35*, 820–835.

Tuberculous mediastinal lymphadenitis results from the persistence or reactivation of the infection which originates with the primary complex. These caseous nodes may erode through the bronchial wall and produce atelectasis. The bronchus of the right middle lobe is particularly vulnerable to this process because of its closeness to a number of lymph nodes and because of its small caliber. In aged white persons the process is very gradual, and healing often

develops before atelectasis. When complete occlusion does take place, producing the atelectasis, the process is often interpreted as carcinoma or some other chronic disease rather than tuberculosis.

The author presents 8 cases in aged white females of atelectasis of the right middle lobe secondary to tuberculous mediastinal lymphadenitis. The patients were not under treatment for tuberculosis when they were first seen. In 2 cases tubercle bacilli were found in the sputum. Symptoms in all patients were mild—cough and expectoration predominating.

The typical roentgen findings of middle lobe atelectasis are described. The pyramidal shaped area of increased density as seen in the posteroanterior view was found in a number of patients. In some, only a few infiltrations could be seen in the posteroanterior film. The right lateral film was found to be of much greater benefit, the atelectasis being adequately demonstrated in nearly all cases. The posteroanterior lordotic view and body section roentgenography were also utilized in selected cases. When an atelectasis in the right middle lobe is found by roentgen examination, a tuberculous lesion might be suspected if (1) calcifications are present in the hilar lymph nodes; (2) the presence or especially the sudden appearance of tubercle bacilli in the sputum is demontrated in the absence of open pulmonary lesions; (3) as anthracosis is usually noted in aged persons, the presence of carbon particles in the sputum might indicate a perforation; and (4) the history of expectoration of a broncholith should also indicate perforation.

The other important bronchial diseases, particularly carcinoma, cause isolated middle lobe atelectasis much less frequently than does perforation by tuberculous lymph nodes.—*W. M. Roy. M.D.*

Lindig, W. Ein klinisch-röntgenologischer Beitrag zum Krankheitsbild der "Mikrolithiasis alveolaris pulmonum." (A clinical-roentgenological contribution to the disease entity "microlithiasis alveolaris pulmonum.") *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Dec., 1951, *75*, 678–684.

Calcifications in the lungs, except for those due to tuberculosis, are quite infrequent. The calcium is deposited in the elastic or collagenous tissue as well as in the walls of the blood vessels. There are calcification deposits which develop in the lung alveoli and lead to a "true" calcification disease of the lungs. Puhr described such a case in 1933 under the name of "microlithiasis alveolaris pulmonum." In view of the very few reports on this disease, the author presents another case.

The case is that of a man forty years of age who had been a gardener until 1936. Since then he worked for a short time in a furniture factory and after that has always been employed in the open air. For ten months he used a pneumatic drill on hard stones, being forced to remain in a dust storm during his work. For the past eight years, he had complained of difficulty in breathing which had gradually become worse. Fluoroscopic examination of the chest in 1944 revealed abnormal findings in the lungs. At this time, there was no cyanosis, vital capacity was 2,900 cc., blood pressure was 110/80. Blood picture was normal, except for a leukocytosis of 12,600. A diagnosis of an unusual malignant form of silicosis was considered. Shortly before the author saw this patient, a lung puncture had been done. Microscopically, calcium deposits were seen within the lung alveoli.

Chest films early in 1945 showed a marked incease in density of both lungs from apex to the third rib anteriorly, due to fine, closely packed, sand-sized, sharply circumscribed nodules, equal in size. Below the third rib anteriorly, there was a homogeneous compact density which obscured the hili, heart and both diaphragms. In the extreme apices, there was an increase in radiolucency suggesting emphysema.

In 1951, the patient still had only a slight reduction in vital capacity (2,800 cc.), had difficulty in breathing, but was otherwise in good condition. Roentgen study of the chest six years after the original one in 1945 showed no appreciable change. It is believed that the roentgen findings are characteristic of the disease described, so that other diseases producing miliary shadows of increased density may be eliminated. The deposits within the alveoli are considered to be calcified amylaceous corpuscles.—*Samuel Richman, M.D.*

Jacobson, George, Cohen, Seymour R., and Carter, Ray A. Pulmonary complications of acute bulbar poliomyelitis. *Radiology*, Nov., 1951, *57*, 629–641.

A group of 53 patients with acute bulbar poliomyelitis was analyzed as to roentgenologically demonstrated pulmonary complications and various clinical features which may have influenced their development.

Pulmonary complications occurred most frequently in patients under six years of age. They developed in twice as many females as males although a higher ratio of males died from the disease.

Early tracheotomy is advocated to reduce the number of pulmonary complications. This gives free air passage beyond the edematous and narrowed upper airway and allows better drainage of the increased pulmonary secretions.

Fifty-eight per cent of the patients had pulmonary complications. Pneumonia, generally involving the upper lobes, was demonstrated in a few cases. Atelectasis was the most common and serious of the pulmonary lesions. This is caused by secretional obstruction which is beyond the reach of the bronchoscope for aspiration. Pulmonary complications were highest among those who had the largest amount of secretion. Pneumothorax, mediastinal emphysema, pulmonary edema, pneumatocele and pleural fluid were also occasionally seen.

Increased intestinal gas was noted in most patients, further increasing difficulty of respiration. The gas was controlled by continuous gastric suction.

Such clinical features as duration of symptoms before admission to the hospital, difficulty in swallowing, paralysis of the diaphragm and intercostal muscles, temperature and initial white blood count gave no suggestion as to which patients might show pulmonary complications.—*E. E. Seedorf, M.D.*

COLE, FRANCIS H., ALLEY, FRANK H., and JONES, RUSSELL S. Aberrant systemic arteries to the lower lung. *Surg., Gynec. & Obst.*, Nov., 1951, *93*, 589–596.

Six cases of aberrant systemic arteries of the lower lobe of the lung are reported. The authors have knowledge of 57 such cases discovered at operation, 42 of them having now been recorded in the literature. This anomaly is much more common than indicated by the earlier literature.

The aberrant systemic arteries originating from the lower thoracic or upper abdominal aorta may be associated with accessory pulmonary lobes, cystic disease of the lower lobe, and diaphragmatic defects. In 2 of the 6 cases reported here, diaphragmatic defects were present, while in the remaining 4 cases there was cystic disease of the lower lobe. The clinical findings depend upon the presence or absence of bronchial communication to the cystic area. With bronchial communication, infection occurs and the findings of marked segmental bronchiectasis are present. In 1 of the authors' cases without bronchial communication no symptoms were present.

Only those aberrant vessels arising below the level of the pulmonary hilus are associated with the cystic disease and diaphragmatic defects. Those originating above the pulmonary hilus are present in anomalies of the heart and great vessels.

The embryologic development of the lower thoracic area is reviewed in this paper and the theories pertaining to the formation of associated anomalies are discussed. These theories stress the determining role of one morphologic aspect without attempting to explain the original developmental error. Present knowledge is inadequate to explain any anomaly, but the association of anomalies of the lung, systemic vessels, and diaphragm suggests a common developmental error involving all structures in the lower thoracic area.—*Mary Frances Vastine, M.D.*

CONWAY, D. J. The origin of lung cysts in childhood. *Arch. Dis. Childhood*, Dec., 1951, *26*, 504–529.

Cysts in the child's lung may be congenital or acquired. Very few have been recorded in stillborn or newborn infants, but it has been generally assumed that most cysts are due to congenital malformation.

The observation is made that in serial roentgenograms cysts of the lung can appear, enlarge, disappear, recur, or alter in number. This strongly suggests the view that these pulmonary cavities are the result of an acquired pathology.

The author concludes that most lung cysts are acquired as a result of bronchial inflammation and obstruction and that very few are congenital in origin.—*J. J. McCort, M.D.*

SMOLLER, SAUL, and MAYNARD, AUBRE DE L. Adenoma of bronchus in a nine-year-old child. *Am. J. Dis. Child.*, Nov., 1951, *82*, 587–592.

The case presented in this paper is that of a nine year old child with an adenoma of the right middle lobe bronchus. The patient was treated conservatively with bronchoscopic removal of the tumor because the parents objected to a thoracotomy. The tumor was of the pure endobronchial type and it was completely removed bronchoscopically. The middle lobe syndrome as described by Graham later developed. The bronchostenosis and the bronchocompression produced by the adenoma and the adjacent enlarged peribronchial lymph nodes resulted in irreversible chronic suppurative disease of the lung. This complication, in addition to the possibility of maligant growth, necessitated surgical intervention. Actually, the syndrome may occur in any lobe or either lung, but the right middle lobe is most susceptible because of its poor drainage.

Roentgenograms of the chest showed the progress of the disease, demonstrating at first an area of increased density in the greater part of the middle lobe of the right lung, with post-biopsy clearing and later recurrence of the dense area. Adenoma of the bronchus is a rare tumor in the pediatric age group.—*R. S. Bromer, M.D.*

DI RIENZO, S. La exploración radiológica en el carcinoma bronquial. (Roentgen examination in bronchial carcinoma.) *Radiología*, Panamá, Dec., 1951, *2*, 33–42.

The diagnosis of bronchogenic carcinoma in a stage early enough for successful surgical treatment requires not only routine roentgenograms in various projections but also films exposed with greater penetration than usual and laminagrams. Bronchograms are also considered of special value, particularly in demonstrating the alterations that take place in the pulmonary dynamics. A bronchus which is invaded by a neoplasm loses motility and does not contract during coughing. Radiopaque oil normally outlines the trachea and primary bronchi by gravity, but the smaller bronchi are filled by aspiration of the radiopaque oil. The failure of the oil to enter the smaller bronchi has been frequently attributed to faulty technique, but in many instances it is undoubtedly caused by loss of elasticity of the parenchyma and bronchus which is involved by a neoplasm. Inasmuch as these smaller bronchi are not accessible to bronchoscopic examination, this observation takes on added importance.

Routine roentgenograms may demonstrate a neoplasm of the mediastinum by enlargement to either side. Endoscopic examinations usually fail to reveal any abnormality until the lesion has actually infiltrated the trachea; however, alterations in the dynamic behavior of the trachea as outlined by a contrast medium during coughing may disclose the presence of neoplasm and may demonstrate an obstruction or deformity which otherwise might not have been seen. Esophagrams, which may show the presence of enlarged mediastinal lymph nodes, and venograms, showing dilatation of vessels proximal to the neoplasm, may also be of value in the early diagnosis of these tumors.—*Murray M. Friedman, M.D.*

Stoll, Roger, Bass, Richard, and Angrist, Alfred A. Asbestosis associated with bronchogenic carcinoma. *Arch. Int. Med.*, Dec., 1951, *88*, 831–834.

The medical literature on asbestosis associated with bronchogenic carcinoma is reviewed and an additional case is reported.

The incidence according to various authors varies; 7.5 per cent to 16 per cent of patients with asbestosis develop bronchogenic carcinoma.

This association emphasizes the hazards of industrial exposure, the compensability of the cancerous process as well as the asbestosis and the need of careful preventive measures.—*F. B. Markunas, M.D.*

Storstein, Ole. Circulatory failure in metastatic carcinoma of the lung; a physiologic and pathologic study of its pathogenesis. *Circulation*, Dec., 1951, *4*, 913–919.

Besides the acute and chronic forms of cardiac failure with cor pulmonale, there is a subacute form which lasts from nine days to two months and is caused by carcinomatous metastases to the lungs. This develops in one of three ways: (1) embolic form, with carcinomatous emboli in the small arteries and occlusion; (2) carcinomatous endarteritis, with tumor cells in the perivascular lymphatics occluding the small arteries by both compression from the outside and invasion of the vessels; and (3) diffuse infiltration of the lymphatics with compression of the vessels but no invasion.

The most common source of the metastases is from the stomach but the lesions may originate in the colon, pancreas, breast or a chorionepithelioma. The metastases usually travel via the thoracic duct to the pulmonary lymphatics but may go via the hepatic vein or inferior vena cava.

The clinical picture is characterized by rapid development of dyspnea and cyanosis followed by right heart failure. Frequently the pulmonary and cardiac signs are predominant and sometimes are the only findings until the primary lesion is demonstrated at autopsy. There is always a low oxygen saturation of the arterial blood. The roentgen findings are not discussed.

The author presents 4 cases, 2 from carcinoma of the breast and 2 from carcinoma of the stomach. Two cases showed hypertrophy of the right ventricle. He stresses two findings: (1) anoxemia and (2) hypertension of the pulmonary artery.—*F. M. Windrow, M.D.*

Jönsson, Gunnar. Selective visualization in angiocardiography. *J. Faculty of Radiologists*, Oct., 1951, *3*, 125–129.

By "selective" angiocardiography the author means that the examiner selects the part of the intrathoracic circulation which he wishes to study, and also that he chooses the method of examination according to the case at hand. Intravenous injection is not always satisfactory because the opaque medium sometimes becomes to diluted. The author has found that selective visualization of the thoracic aorta, *i.e.*, thoracic aortography is one of the most useful branches of angiocardiography. He has adopted Fariñas' and Radner's method of insertion of a catheter into the aorta via a peripheral artery. After exposure of the radial artery under local anesthesia a heart catheter (size 8 to 10 F.) is inserted through it up to the aorta. Then 50 to 80 cc. of a 70 per cent solution of diodone is injected as rapidly as possible with the aid of a pressure apparatus. The roentgenograms are taken into perpendicular planes simultaneously at a rate of ten pairs of films per six to eleven seconds.

The author discusses the facts desired by the surgeon in cases of coarctation: the length and degree of the stenosis; the distance from the stenosis to the origin of the subclavian artery; if and how much the stenotic area is dislocated forward at the level of the ligamentum Botalli; the diameter of the aortic arch; the collateral circulation; whether other malformations are present. Patent ductus arteriosus may be suspected clinically, but the murmur may not be continuous; gas analysis may show evidence of a communication between aorta and pulmonary artery, but this could be due to some form of shunt other than a patent ductus. Visualization of the patent ductus arteriosus by thoracic aortography gives conclusive proof of its existence.

In studying malformations of the right ventricle, the author inserts a slender catheter through a cubital vein and makes the injection with the same pressure apparatus as is used for aortography. The contrast medium is injected with a steady flow through the right ventricle for three or four seconds giving a chance to obtain roentgenograms in both diastole and systole.—*Samuel G. Henderson, M.D.*

Figley, M. M., Stern, A. M., Wilson, J. L., and Hodges, F. J. Angiocardiographic observations in some correctible types of congenital cardiovascular disease. *J. Michigan M. Soc.*, Dec., 1951, *50*, 1378–1387.

The authors report on the study of 122 angiocardiographic observations at the University of Michigan Hospital in Ann Arbor. Preliminary circulation time tests are not utilized and roentgenograms are usually made every half-second on a specially constructed device which provides automatic exposure of 11 by 11 inch frames on a long roll of film for a total of thirty films. Prophylactic penicillin and antihistamine drugs are given prior to the injection.

This paper limits itself to correctible types of congential cardiovascular disease, and in it the authors take up the diagnostic criteria for coarctation of the aorta, patent ductus arteriosus, tetralogy of Fallot, pulmonary valvular stenosis with intact ventricular septum, tricuspid atresia with underdeveloped right ventricle. The roentgenograms reproduced are excellent in quality and the value of these is greatly augmented by line diagrams which accompany the illustrations.

The authors feel that the procedure is of particular value in establishing the exact diagnosis of lesions producing cyanosis. It makes possible differential diagnosis between coarctation of the aorta and several types of cyanotic heart disease. It has not been particularly helpful in the differentiation between patent ductus arteriosus and other lesions causing a left-to-right shunt.—*C. L. Hinkel, M.D.*

ELVIDGE, ARTHUR R., and WERNER, ALOIS. Hemiplegia and thrombosis of the internal carotid system. *A. M. A. Arch. Neurol. & Psychiat.*, Dec., 1951, *66*, 752–783.

The clinical recognition of thrombosis of the carotid vessels has been made possible by angiography. A reasonably clear-cut clinical entity can now be defined.

In the light of the results of ligation of the internal carotid artery and of observations in asymptomatic cases of thrombosis of the carotid artery, the relationship between the clinical manifestations and the demonstrated occlusion is not at all clear. The entity had better be termed "syndrome of the internal carotid system" rather than "carotid hemiplegia" or "syndrome of thrombosis of the internal carotid artery."

The condition has been reported in all age groups. It occurs more frequently in men and in the left artery.

Two types of history are given. In the first, there is a story of transient, recurrent episodes of similar pattern, as a rule less severe than that for which the patient is finally referred to a specialist. In the second, the onset of the hemiplegic syndrome is not preceded by disorders of the same pattern.

Thrombosis of the internal carotid artery seems sooner or later to lead to hemiplegia which may be associated with impairment of vision, hemianoptic disturbances, and aphasia if the lesion is on the dominant side; occasionally, the condition is not associated with definite neurological signs. Epileptic seizures and convulsions are rare.

Electroencephalograms show slow delta waves of varying amplitude, localized to the frontotemporal region of the involved side.

Roentgenograms of the skull are helpful in differential diagnosis. Patients with the syndrome present normal findings, except that calcifications in the pineal and choroid plexuses are sometimes shifted due to atrophy of the affected side. Demonstration of the carotid canals rules out congenital absence of the carotid artery.

Pneumoencephalography demonstrates varying degrees of dilatation of the lateral ventricle on the affected side, the extent of change depending upon the amount of cerebral atrophy.

Cerebral angiography is most important. Failure to visualize the dye in the vessel does not necessarily mean that it is thrombosed, nor does mere filling of a vessel exclude thrombosis; irregularities in the diameter of the vessel must be considered. Conical narrowing of the column of dye before it stops is good evidence of thrombosis. The commonest site of thrombosis is just distal to the bifurcation of the common carotid. Other sites are at the anterior clinoid process and at the foramen lacerum.

Occlusion of the internal carotid artery may be due to an embolus, more frequently to thrombosis. The latter may be retrograde from an arterial ligation or thrombosed aneurysm, or it may be a complication of arteriosclerosis, thromboangiitis obliterans, acute infections, syphilis, direct trauma, or disease of neighboring tissue. Compression of the artery by a neoplasm may be the precipitating factor.

There is as yet no good treatment for the condition, but attempts are being made to increase the collateral blood flow from the opposite side and to prevent vasoconstriction on the same side. The authors report 13 cases of their own.—*George Cooper, M.D.*

DOLLY, CYRIL H., DOTTER, CHARLES T., and STEINBERG, ISRAEL. Ventricular aneurysm in a 29-year-old man studied angiocardiographically. *Am. Heart J.*, Dec., 1951, *42*, 894–899.

Aneurysm of the anterolateral wall of the left ventricle follows approximately 9 per cent of myocardial infarctions. It may develop at any time from a week to several years following infraction, the average period of time being 17½ months in one series of cases reviewed. Calcification in the wall of the aneursym is not uncommon; the same is true of thrombus formation within the sac. Principal diagnostic features include evidence that coronary occlusion has occurred and the demonstration of a localized bulge of the heart wall. The most deci-

sive diagnostic point has been the fluoroscopic, roentgen kymographic, or electrokymographic demonstration of expansile (paradoxical) systolic pulsation of the mass. It is, however, difficult to distinguish tumors contiguous to the heart, particularly so when thrombus formation within an aneurysmal sac has limited pulsation.

The case of a twenty-nine year old Negro male who had had an episode of severe chest pain three years previously is presented. On roentgen study a localized, rounded shadow contiguous with the anterolateral wall of the left ventricle was found. The periphery of the mass contained faint calcific deposits. Paradoxical pulsation was demonstrated fluoroscopically and by roentgen kymogram. An electrokymogram proved the existence of marked systolic expansion in the diseased area. The electrocardiogram revealed evidence of previous myocardial infarction.

On angiocardiography a frontal film exposed 10½ seconds following intravenous injection of 45 cc. of 75 per cent neo-iopax revealed filling of the left side of the heart and aorta as well as opacity of the aneurysmal cavity which was round, about 6–7 cm. in diameter, and arose from the left ventricle anteriorly.

According to Friedberg, ventricular aneurysm must be roentgenologically differentiated from cardiac tumor, localized pericardial effusion, pericardial cyst, aneurysm of the sinus of Valsalva, localized pericardial calcification, myocardial gumma, aneurysm of the descending aorta, and enlargement of the pulmonary conus. Angiocardiography can be depended upon to make this differentiation. The authors have studied 3 other cases of ventricular aneurysm in which the angiocardiograms showed the aneurysmal cavities as outpocketings of the opacified left ventricle. They found, however, that the angiocardiogram reveals little difference between small ventricular aneurysms and the appearance of the left ventricle following massive myocardial infarction. In the latter case, the ventricle appears as though in perpetual diastole. Normally, the left ventricular wall is poorly shown by angiocardiography since it moves rapidly during ventricular activity and since during systole the papillary muscles are closely approximated, displacing contrast substance (and blood) away from the peripheral portions of the cavity. It is only when angiocardiographic exposures are made (fortuitously or by means of electrocardiographic control) during ventricular diastole that the chamber is completely shown and the wall clearly outlined. This situation occurs regardless of the phase of the cardiac cycle in patients who have had massive infarction of the left ventricle. The principal angiocardiographic difference between massive infarction and what is generally thought of as ventricular aneurysm is the localized nature of the bulge or outpocketing seen in the latter lesion.—*Harold Fulton, M.D.*

López, Efrén Gulliermo Jurado. Los métodos radiológicos en el diagnóstico de un aneurisma del corazón. (Roentgenologic methods in diagnosis of a cardiac aneurysm.) *Radiología*, Panamá, Dec., 1951, *2*, 43–48.

The case of a forty-five year old man, whose chest roentgenogram disclosed a smoothly contoured, rounded soft tissue shadow measuring 6 cm. in relation to the left border of the mediastinum, is used as an example to demonstrate the procedures employed in making a systematic investigation of this condition.

The routine chest film disclosed a line of calcification in the inner third of this extra density. Roentgenograms made in lateral projections and a Bucky film of the chest with the patient in a decubitus position were employed to demonstrate the relationship of this shadow to the descending aorta. A series of laminagrams showed the relationship of the aneurysm to the left ventricle, pericardium and also an area of pulmonary atelectasis adjacent to the aneurysm. Fluoroscopic examination failed to reveal paradoxical involvement, but the absence of this sign was attributed to the calcification of the walls and the formation of an organized thrombus in the aneurysmal sac. Angiocardiograms were made and conclusively demonstrated the continuity of the cavity of the aneurysm of the left ventricle.—*Murray M. Friedman, M.D.*

Janker, R. Der offene Ductus Botalli im Röntgen-Kinofilm. (Patent ductus Botalli in roentgen cinematography.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Dec., 1951, *75*, Supp., 79–92.

The preoperative diagnosis of a patent ductus Botalli is of prime importance since this condition is readily amenable to surgery before valvular failure or endocarditis supervenes. It is imperative to exclude any co-existing congenital anomaly which would be a contraindication to closure of the ductus, *e.g.*, stenosis of the aortic isthmus. While it is often impossible to demonstrate the actual communication between the aorta and pulmonary artery, the indirect signs are quite characteristic: (1) separate filling of of the auricles and ventricles (in the absence of a septal defect); (2) dilatation of the pulmonary conus and its branches; (3) increased and prolonged filling of the lesser circulation; (4) an energetic to-and-fro motion of the pulmonary conus or main stem of the pulmonary artery; (5) rhythmic re-filling of the pulmonary artery from the arota.

The first three signs are fairly easily recognizable by conventional angiocardiographic technique but cinematography is the best method for demonstrating the last two signs. Among 400 angiocardiographic examinations, 18 showed an isolated patent ductus Botalli, all verified at operation. Illustrative films

from 9 cases are presented in this article. The more difficult procedure of retrograde aortography is rarely used, and the author has found intracardiac catheterization difficult, if not occasionally impossible, in the young. Conventional precautionary measures and angiocardiographic techniques are employed.—*Joseph Zausner, M.D.*

LEVENE, GEORGE, and KAUFMAN, SEYMUR. Roentgenologic aspects of congestive heart failure. *Radiología*, Panamá, Sept., 1951, *1*, 243–250.

The authors describe the roentgen findings in right and left ventricular failure.

In the earliest stages of left ventricular failure, the roentgenograms show enlargement of the pulmonary vascular shadows. Progression of the process causes hazy areas in the lung fields due to pulmonary edema.

In the event of right ventricular failure, which usually is secondary to left ventricular failure, the lung fields may become clearer due to the decrease in the amount of pulmonary edema. However, the pulmonary vessels remain prominent, fluid accumulates in the pleural cavity, the heart borders become more oblique, the cardiohepatic angle is widened and the vascular pedicle and superior vena cava are widened.

Barium studies of the esophagus in left ventricular failure show a single pressure deformity, while a double curve resembling a "reversed three" is seen in cases of right and left sided failure.—*F. B. Markunas, M.D.*

CHAMBLISS, J. R., JARUSZEWSKI, E. J., BROFMAN, B. L., MARTIN, J. F., and FEIL, H. Chronic cardiac compression (chronic constrictive pericarditis); a critical study of sixty-one operated cases with follow-up. *Circulation*, Dec., 1951, *4*, 816–835.

This report is based on the study of 61 cases of chronic cardiac compression operated upon at the University Hospitals of Cleveland. Compression of the heart results when the rigid encasing scar contracts and encroaches upon it, preventing adequate filling and ejection. A diffuse scar alone causes no physiologic derangement, as is illustrated by the high incidence of adherent pericardium without compression. It is a relatively rare disease predominantly affecting young men. The commonest symptoms in this series were dyspnea, ascites, edema and orthopnea. The typical physical findings were venous distention, decreased precordial activity, distant heart sounds, pleural fluid or thickened pleura, and enlarged liver and ascites and/or edema. Electrocardiographic findings included low voltage and primary T-wave changes. Many had some type of arrhythmia and notched P-waves.

Roentgenologic studies showed diminished cardiac pulsations in all cases and complete absence of pulsations in some. Fixation and lack of change of the cardiac silhouette were observed during inspiration, and change in the position of the patient often revealed diminished lateral shift. The transverse diameters of the hearts were often within normal limits although about half were somewhat increased. Almost half the patients had pericardial calcification, and frequently this was very extensive so that it encased the heart almost completely. The calcification usually spared the base of the heart, the common locations being the posterior portion of the pericardial sac, the apex and the left margins. Widening of the superior mediastinum, probably due to engorgement of the superior vena cava and mediastinitis, was quite common. Diminished pulsations of the aorta were noted in well over half the cases. The majority of the cases had pleural thickening or effusions, often quite extensive.

The operative mortality was 18 per cent and satisfactory results were obtained in 72 per cent. The outcome was less favorable when there was preoperative cyanosis or evidence of tuberculosis preoperatively. In 6 cases more than one operation was necessary. Postoperatively all circulatory function tests tended to return to normal with the exception of persistent primary T-wave changes. Roentgen examinations nearly always revealed improvement in the amplitude of pulsations. In some patients the heart size was unchanged, in some it was increased and in some diminished. In many cases the pericardial calcification was incompletely removed.

Tuberculosis was proved to be the etiologic factor in 28.2 per cent of the cases, and in no instance was rheumatic fever shown to be responsible.—*A. E. Childe, M.D.*

ZOLL, PAUL M., WESSLER, STANFORD, and SCHLESINGER, MONROE J. Interarterial coronary anastomoses in the human heart, with particular reference to anemia and relative cardiac anoxia. *Circulation*, Dec., 1951, *4*, 797–815.

This excellent paper presents the results of a study of coronary interarterial anastomoses in a series of 1,271 human hearts examined by a uniform technique of injection and dissection. In each case radiopaque lead agar mass of different colors was injected into the main coronary arteries, the heart was unrolled, a roentgenogram was made and finally the coronary arteries were dissected using the roentgenogram as a guide. On the basis of careful dissection three types of proof of anastomoses were accepted: (1) demonstration of a continuous, stained, endothelial-lined connecting channel filled with mass between two coronary arteries; (2) presence of injection mass of any color distal to an occlusion; and (3) visualization of a mixture of color in the injection mass.

A definite, statistically significant relationship was found between a number of factors and the develop-

ment of human intercoronary arterial anastomoses. In the absence of these stimulating factors less than 10 per cent of human hearts presented anastomoses, and if all the etiologic factors had been known, the incidence might have been still lower. The previous observation that marked narrowing and complete occlusion of the coronary arteries are the most important factors in the production of interarterial coronary anastomoses was firmly established. Eighty-nine to 100 per cent of hearts with coronary occlusion were found to have such interarterial coronary anastomoses, but with coronary narrowing, the anastomoses were less frequent. The incidence of anastomoses in hearts from anemic patients was 39 per cent, with cor pulmonale 73 per cent, with cardiac hypertrophy 26 per cent and with valvular disease 28 per cent. In normal hearts from nonanemic patients the incidence was only 9 per cent, but in normal hearts from anemic patients it rose 35 per cent.

It is concluded that the factor of relative cardiac anoxia that is present in all these conditions is the common underlying stimulus for the development of interarterial coronary anastomoses.—*A. E. Childe, M.D.*

Forsyth, Constance C., and Uchida, Irene. Auricular septal defect in one of monozygotic twins. *Arch. Dis Childhood*, Dec., 1951, *26*, 582–587.

This is the report of a six year old girl with an auricular septal defect in one of monozygotic twins. In the other twin the heart was normal. It has been considered that one of homologous twins never suffers from malformations not shared by the other. The authors go to great length to prove that they are dealing with monozygotic twins and that the case reported actually has a cardiac defect while the other twin is normal. The authors would like to conclude that the two individuals came to differ in uterine life after conception.—*R. E. Kinzer, M.D.*

Bland, Edward F., and Jones, T. Duckett. Rheumatic fever and rheumatic heart disease; a twenty year report on 1,000 patients followed since childhood. *Circulation*, Dec., 1951, *4*, 836–843.

The authors present a study of 1,000 consecutive cases of rheumatic fever, all of which have been followed for at least twenty years. The cases were first seen between 1921 and 1931 so that many have been followed twenty-five or more years. They were observed at six to twelve month intervals or more often if they were ailing.

The over-all mortality rate was 20 per cent at the end of ten years and 30 per cent at the end of twenty years. Rheumatic fever and congestive failure accounted for 80 per cent of the deaths and bacterial endocarditis for an additional 10 per cent. Cardiac enlargement at any stage is an ominous sign but is particularly bad in the acute stage. The mortality rates in pericarditis, subcutaneous nodules and active arthritis cases were 63 per cent, 37 per cent and 27 per cent, respectively. In contrast, chorea was found to be associated with a benign form of the disease, with a mortality rate of only 12 per cent.

Recurrence of rheumatic fever or chorea was about 20 per cent during the first ten years and 10 per cent during the second ten years. A pure mitral stenosis evolved in about 12 per cent of the cases, but in only about 10 per cent of these did any serious pulmonary hypertension appear. Of the 70 per cent who survived twenty years 3 out of 4 remained entirely normal with no limitation of activities.

On recovery from the initial illness, 65 per cent had signs of rheumatic heart disease. At the end of twenty years these signs of rheumatic heart disease had disappeared in 16 per cent of the cases. Of the 35 per cent who recovered with no signs of rheumatic heart disease 44 per cent developed valvular heart disease during the subsequent twenty years.

This report gives a more favorable outlook on rheumatic fever than that usually accepted because it reports 1,000 consecutive cases and not just the severe or complicated ones which are frequently followed for obvious reasons. All of the cases were observed in their initial period before the advent of the present day antibiotics and therefore the present outlook on the disease may be even more optimistic than for the presented cases.—*F. M. Windrow, M.D.*

Chesky, V. E., Dreese, W. C., and Hellwig, C. A. Hürthle cell tumors of the thyroid gland; a report on 25 cases. *J. Clin. Endocrinol.*, Dec., 1951, *11*, 1535–1548.

This report is based upon 25 cases of this type of thyroid tumor which represented 5 per cent of all the solitary tumors of the thyroid seen by the authors during the last ten years. Twenty-four of these tumors were in females and the average age of the patients was fifty years. Nine of the patients had toxic symptoms although the Hürthle cell tumor itself had no endocrine function. Twenty-two of the patients are alive and 20 are without evidence of disease from one and one-half to nine years after thyroidectomy. In the fatal cases the average duration of life after operation was six and one-half years.

As a result of this study the authors are unable to decide whether the Hürthle cell tumor is benign or malignant. The clinical course of this tumor suggests that adequate local removal may produce a cure.—*Robert P. Barden, M.D.*

Kergin, Frederick G. Congenital cystic disease of lung associated with anomalous arteries. *J. Thoracic Surg.*, Jan., 1952, *23*, 55–65.

The etiology and pathology of congenital cystic disease of the lung associated with anomalous arteries are reviewed and discussed. The conclusion that the anomalous vessel is the primary etiologic

factor in this so-called "sequestration of the lung" is supported by the author.

Five cases of this condition, all treated by lobectomy, are reported. One of these cases showed an unusual association of both intra- and extralobar sequestration in relationship to the same lower lobe. Observations which tend to prove that circulation through the anomalous artery constitutes an unusual type of shunt are described.

It is suggested that the clinical and roentgenographic features of this lesion are sufficiently typical to permit a correct preoperative diagnosis. The pathologic condition found at operation is usually recognizable with ease. Excision of the diseased segment or lobe is a satisfactory method of treatment.—*T. C. Stansbury, Jr., M.D.*

Glücker, L. G., and Munk, J. Roentgenologic pulmonary manifestations of Queensland fever. *J. Faculty of Radiologists*, Jan., 1952, *3*, 186–192.

Queensland fever which was noted for the first time by Derrick in 1937 in Queensland, Australia, is caused by a Rickettsia—*Coxiella burneti*—found in the blood of Q fever patients. The proof of the antibodies in the blood serum by a complement-fixation test is specific in diagnosis. The author describes the pulmonary roentgenological features and discusses roentgen differentiation from other pulmonary diseases of an inflammatory character.

Pathologically, according to Boyd, the changes are similar to those of primary atypical pneumonia. The principal lesion is a mononuclear infiltration of the walls of the bronchi, with edema of the alveoli.

Roentgenologically, the predominant feature is a circumscribed lesion of exudative-pneumonic character. In the acute stage (fourth to twelfth day of disease) the authors found a well circumscribed, rounded, homogeneous, ill defined shadow of low to middle density, usually but not always in a lower lobe. The size of the lesion varied from that of a plum to that of an apple. This represents the exudative type of lesion (exudation into the alveoli).

In the stage of resolution (second to third week) interstitial infiltration, appearing as structural intensification on the film, becomes more evident roentgenologically. The lesion loses its density and homogeneity. In its center there is seen a small shadow similar in density to that of the original lesion and surrounded by a zone of structural intensification. At this stage linear shadows linking the lesion to the hilus (drainage of the area) may be seen. The central lesion gradually disappears and a residual zone of structural intensification may remain for many weeks. These changes occur in reverse order in primary atypical pneumonia.

The pulmonary lesion of Q fever, with its roentgen appearance of exudative-pneumonic character, cannot be distinguished roentgenologically from many lesions of similar pathological type, such as primary tuberculous lesions, early tuberculous lesions (Assman) and eosinophilic infiltration. However, it is usually possible to distinguish roentgenologically between primary atypical pneumonia and Q fever. In the former there is first seen evidence of interstitial inflammation—marked intensification of the lung markings linking the hilus to the involved area. Associated with this there is segmental distribution. Later, lobular, segmental, or lobar atelectasis due to bronchial obstruction appears. In Q fever there is no segmental distribution. Its main feature is a parenchymal lesion of exudative pneumonia type which retains its character up to the complete resolution of the lesion. In primary atypical pneumonia the interstitial infiltration (structural intensification) is the main roentgen finding, dominating the picture throughout its course. In Q fever the interstitial infiltration becomes more apparent during the stage of resolution.—*Samuel G. Henderson, M.D.*

Gowen, G. Howard, and Frank, Bernard. Screening for chest pathology using mass x-ray survey technic. *Ann. Int. Med.*, Jan., 1952, *36*, 138–145.

Since lung tumors are detectable even during their clinically "silent phase" on the chest roentgenogram, the authors consider the mass chest survey as the only medium by which detection of chest tumors can be speeded up. This function can be performed without alteration of the extensive tuberculosis surveys at present under way, except for closer attention to the group of films commonly classified under "Other Pathology" than tuberculosis.

This article deals with a survey made in urban and rural Illinois population composed of 157,000 films. Of this group, 307 (0.2 per cent) had findings suggestive of neoplasm. From this small percentage of the original survey, 14 actual lung malignancies were finally confirmed and 10 nonmalignant neoplasms of the lung were detected. A number of other less serious lesions such as substernal thyroid (16 cases), pleural thickening (3 cases), coin lesions (1 case), etc., were uncovered. In this survey, there were 10 primary carcinomas of the lung out of the group of 14 lung malignancies, and unfortunately 9 out of this 10 were far advanced lesions.

Other conditions detected during this survey included cardiac abnormalities. The case rate for the fully reported cases was 171.29 per 100,000 persons surveyed. If all questionnaires had been returned and fully filled out, a projected case rate of 488.4 per 100,000 persons surveyed would have been achieved.

In view of the significant number of cases of cancer and cardiac disease detected from this particular survey, it would seem advisable to investigate all cases classified usually under "Other Pathology." The authors suggest that cooperation between

the Tuberculosis Association, the Heart Association, and the Cancer Society would be well worth while in this matter.—*William A. Klauber, Jr., M.D.*

Porte, Daniel. Detection of heart disease in a mass chest x-ray survey for tuberculosis case-finding. *Ann. Int. Med.*, Feb., 1952, *36*, 603–606.

The usefulness of survey films for the detection of cardiovascular lesions was checked in the Queensboro Tuberculosis and Health Association survey for tuberculosis. Negative roentgen findings from a cardiovascular standpoint cannot be considered to mean normal conditions, but positive findings may be of great value.

In all, 6,579 patients over fifteen years of age were examined by 70 mm. films; 87 cases showed possible cardiac abnormality. These cases were requested to return for further study consisting of history, standard roentgenogram, 9 lead electrocardiogram, blood pressure and physical examination. Of these patients 17 did not return, 19 (0.3 per cent) had heart disease previously unknown, 26 had known cardiovascular lesions and 25 were negative. Of the heart disease patients, 32 had hypertensive and arteriosclerotic heart disease, 12 had rheumatic heart disease and 1 arteriosclerotic heart disease without hypertension. In the total group 0.14 per cent had active tuberculosis.

In 1949 and 1950, $1.00 roentgen films were taken on 30,072 persons, many of whom were suspected of having thoracic disease. Of these, about 1 per cent showed suspected pulmonary lesions and 2.5 per cent had abnormal cardiac shadows. As expected, abnormalities of the cardiac contour proved more significant than apparent enlargement of the heart.

Mass survey for cardiovascular disease compares favorably with the detection of tuberculosis in productivity, time required, and cost.—*Martha Mottram, M.D.*

Theodos, Peter A., and Gordon, Burgess. Tuberculosis in anthracosilicosis. *Am. Rev. Tuberc.*, Jan., 1952, *65*, 24–47.

The incidence of pulmonary tuberculosis in 750 male hard coal miners with various stages of anthracosilicosis was 12.9 per cent. The present study includes a group of cases, 85 per cent of which were sufficiently disabled from chest disease to have stopped work. Exposure to silica dust averaged 29.1 years for the infected group; 75 per cent of the cases were in the fourth and fifth decades of life.

Classification of the roentgenographic chest findings was based on a modification of the system proposed by the Committee on Pneumoconiosis of the American Public Health Association according to which nodules up to 2 mm. in diameter are called first stage, nodules up to 5 mm. in diameter are called second stage, and larger nodules are called third stage.

The diagnosis of early tuberculosis in the silicotic lung is often difficult. Far advanced tuberculosis was easily recognized. In nearly 70 per cent of the tuberculous patients cavities were present. Conglomeration of previously discrete nodules, asymmetry of shadows, tracheal shift and restricted diaphragm motion occurred in a high percentage of cases. In 83 of suspect cases simple direct smear demonstrated tubercle bacilli. The remaining 15 per cent were identified by usual ancillary methods.

The life expectancy of patients suffering from silicosis with complicating tuberculosis is short. With skilled sanatorium care a survival of four years or longer may be obtained. Of the entire group, two-thirds will be dead within three years of the development of manifest tuberculosis.—*Edward Julien, M.D.*

Thomas, R. W. Silicosis in the ball-clay and china-clay industries. *Lancet*, Jan. 19, 1952, *1*, 133–135.

Ball-clay and china-clay are found as natural deposits in Devon, Dorset and Cornwall. They are alteration products of granite, the feldspar of the granite being converted into kaolin and silica by hydrothermal action and weathering.

China-clay is washed away from the natural deposits by a hose, settled out and dried by kiln in preparation for grinding. It has many uses other than pottery. Ball-clay is mined under damp atmosphere and ground in preparation for use in pottery industry and as a bonding material in other industries.

The dust risk is present in the late stages of manufacture; *i.e.*, in the drying, the mill and in bagging the powdered clay. It has been the general belief of workers and management in these industries that no hazard was present and that respiratory disease was not unduly prevalent. No large scale investigation has been made and the data available are scanty. In pottery, ceramic and refractory industries, pneumoconiosis seems to be due to free silica rather than kaolin. A few reports would suggest kaolin as the responsible agent.

Cornish china-clay is kaolinite which on chemical analysis has less than 3 per cent of free silica. Ball-clay has from 5 to 29 per cent free silica depending on the source.

Two cases are reported. The first case is that of a man, aged sixty-one, who, except for short intervals, had spent his whole working life in the ball-clay industry. He has had a few attacks of bronchitis, no hemoptysis but has been complaining of increasing dyspnea on effort for the last three years. A roentgenogram of the chest showed generalized coarse discrete nodulation in both lungs. At necropsy, the lungs exhibited a fairly advanced typical silicosis,

numerous well-defined black silicotic nodules with marked emphysema between them. Microscopically, the silicotic nodules appeared to be less concentrically whorled than usual, the intervening lung showed a mixture of irregular reticulin thickening alternating with extreme emphysema. There was no sign of infection.

The second case is that of a man, aged fifty-six, who worked for twenty-five years with china-clay. There was no industrial history compiled so that the findings were confined to those of necropsy. In the lungs, there was a dense mass of tuberculo-silicotic tissue occupying the basal half of the apical lobe and upper quarter of the basal lobe. There were a moderate number of small classical silicotic nodules and a moderate degree of emphysema.

The evidence pointing to a dust hazard in the ball-clay industry may not be very strong. The first patient, however, judging from the clinical, pathological and roentgenological findings, had silicosis due to his employment, so that a certain risk does exist in any industry handling powdered clay. The evidence in the china-clay worker is not sufficient to say that he contracted his disease from exposure to china-clay dust. The work of Kettle suggests that in association with tuberculosis, this dust can produce a fibrosis of silicotic type.

It is recommended that routine chest examinations be done and further investigations carried out.—*George H. Ramsey, M.D.*

Steinberg, Israel, and Dotter, Charles T. Lung cancer; angiocardiographic findings in one hundred consecutive proved cases. *A.M.A. Arch. Surg.*, Jan., 1952, *64*, 10–19.

Angiocardiographic study of the pulmonary circulation in this group of patients showed a significant number in which irregular stenosis or occlusion of the central pulmonary artery could be shown. While this is not specific evidence of a malignant tumor it is a very suggestive finding especially when taken in conjunction with other methods of diagnosis. Furthermore, the authors feel that certain findings on angiocardiograms indicate inoperability or incurability by surgical means. These include: (1) partial or complete occlusion by tumor of the left pulmonary artery within 1.5 cm. of its site of origin or of the right pulmonary artery proximal to its point of bifurcation; (2) partial or complete occlusion of the great mediastinal vein; (3) demonstration of mediastinal metastases by evidence of displacement and deformities of vascular structures within the mediastinum; (4) demonstration of pericardial invasion by tumor indicated by localized thickening of the pericardium in the absence of pleural disease.

The authors feel, therefore, that the use of this method may increase the diagnostic accuracy in the study of patients with chest diseases and may add to the ability of the physician to arrive at a proper prognosis and thus a proper method of therapy.—*Robert P. Barden, M.D.*

Garry, T. P., and Solomons, Edward. Thoracopagus; report of a case with obstetrical and anatomical details and some embryological references. *J. Obst. & Gynaec. Brit. Emp.*, Feb., 1952, *59*, 45–51.

The double monster displayed on inspection and by dissection two symmetrical, diverging, fully developed heads. There were two common, completely developed, normally placed upper limbs, right and left, and two lower limbs. The trunks were united dorsally in the thoracic region by fused ribs and in the lumbar region by fused transverse processes. Fusion in the sacrococcygeal area took the form of a common sacrum and coccyx.

Ventral union was represented by a common sternum and a common symphysis pubis. There were two distinct full-grown converging vertebral columns, which merged caudally into the common sacrum and coccyx. The common thoracic cavity contained two distinct hearts whose ventricular walls were juxtaposed and joined slightly.

Two lungs were located cheek to jowl in the thorax of the left twin, one of which was perfectly developed while the other was in a somewhat shrivelled rudimentary state.

Chief interest centers round the presence of abdominal organs in the common thoracic cavity, and continuity was seen to be established through the diaphragmatic hiatus between the anomalously placed parts of the intestinal tracts.

Below the diaphragm was a common abdominal cavity. One completely developed liver, with a single gallbladder, was common to both twins.

The ascending, transverse, descending and pelvic colons (marked by the usual characteristics), rectum and anal canal were all of normal caliber. The anal orifice was patent and placed medianly immediately in front of the root of the rudimentary penis.

There were three kidneys present, all fully developed, lobulated and subdiaphragmatically situated.

Teratological terminology is not standardized and is therefore somewhat confusing. According to authorities in the matter, the specimen under review could be appropriately labelled duplicatus anterior, or thoracopagus, or dicephalus.

The exact mode of origin of the double monster is still obscure, and it is still an open question whether they are the union or division of embryonic rudiments. Our knowledge of the ultimate causes of double monsters is still of a very hypothetical nature. From clinical and experimental evidence, trauma of various nature appears to be the most important. Whether physical, chemical and osmotic conditions, which certainly play a part in experiments on animals, also have an influence in the case of human subjects is still more doubtful.—*Eugene J. McDonald, M.D.*

Effler, Donald B. Chylothorax; a conservative method of management. *Cleveland Clin. Quart.*, Jan., 1952, *19*, 6–11.

Chylothorax is usually produced by direct trauma to the thoracic duct. In the past this was usually caused by penetrating wounds but in recent years surgical injuries have become the principal cause as a result of more frequent intrathoracic procedures. As a surgical complication, the chylous effusion may not appear for a period of a few days to a week, suggesting that the fistula was secondary to impaired blood supply and local ischemic necrosis. Symptoms are a result of fluid in the chest and of inanition due to loss of fat, protein, fluid and electrolytes. Treatment has included ligation of the thoracic duct, multiple thoracenteses with intravenous injection of the aspirated chyle, oral starvation and periodic needle aspiration. In 1938 the literature revealed a mortality rate of 50 per cent, usually as a result of inanition and dehydration.

The authors present a case of a fourteen month old girl who was operated upon for a retro-esophageal right subclavian artery arising from the left descending aorta. Five days later she developed a left chylothorax. She was placed on oral starvation but the fluid continued to reform at the rate of 400 cc. a day. Five days later a Foley catheter was placed into the pleural cavity and connected to water-seal suction. The measured fluid decreased from 800 cc. a day to 40 cc. nine days later. On the twelfth day the catheter was removed after complete expansion of the lung had occurred and no fluid reaccumulated on clamping the tube. During this period she was on skim milk feedings. Recovery was complete.—*H. J. Klos, M.D.*

Lenzi, Mario, Elimination of the water-soluble contrast medium in bronchography. "Functional bronchography." *Acta radiol.*, Feb., 1952, *37*, 103–110.

Iodized oil has been generally used as the contrast medium in bronchography. During the last few years water-soluble, absorbable contrast substances have also become available for this purpose. Iodized oil is not absorbed; therefore, this medium can only reproduce the morphologic appearance of the bronchial tree. The water-soluble contrast substances (umbradil, ioduron B, viskiosol, etc.) on the other hand, are absorbed in a relatively short time. By studying the absorption time it is possible to gain an idea of the functional condition of the bronchi.

In the normal subjects who have been examined up to the present, complete absorption has been found to take place in a period which varies from thirty to forty-five minutes. The absorption time is longer in the elderly patient and shorter in the child. There are no appreciable differences in the sexes nor with the various types of water-soluble media. Absorption takes place in the bronchi as well as in the alveoli.

Two stages of bronchography are usually differentiated as follows: the bronchial stage in which the bronchi are filled with contrast and the alveolar stage in which the contrast has passed out into the alveoli. Using the water-soluble contrast, a third stage, in which the contrast is being absorbed, may be considered. In this stage the lymphatic and venous vessels, more or less filled with contrast, present a knotty, net-like appearance, a sort of "spotty" image. As the contrast is absorbed, the net-like structure becomes less apparent and gradually fades away. This third stage may be called the lymphovenous stage and be said to represent pulmonary lymphovenography.

If the absorption time has been short and a large amount of contrast medium has been used, it is possible to demonstrate the latter in the urine by the time that it has been completely absorbed.

With this contrast one is able to examine different areas of the lungs separately and successively at one bronchographic examination. Also, the same zone may be re-examined many times if this is desired. This was not possible with the non-absorbable iodized oils.

The author has examined 300 cases without any complications to date. High fever and hemoptysis would seem to be the only contraindications to using the method. The water-soluble contrast media will mix with the secretions of the bronchial tree while the iodized oil will not. Thus, when using the water-soluble substances the bronchi will be filled with the contrast so that the roentgen findings are more accurate.

In the author's experience, the average absorption time is thirty to forty-five minutes, as previously noted. Cases of quick absorption are rare. Rapid absorption may occur in hyperthyroidism, in tachycardia or in the presence of fever. Cases showing prolonged absorption are more common. They are seen in the face of any process which alters the normal bronchial and alveolar permeability or that interferes with the general normal anatomo-functional properties of the broncho-alveolar walls. A typical example is afforded in cases of bronchiectasis in which the contrast medium remains for seven, ten and even twelve hours or more with a very slow absorption rate, and therefore without an appreciable venous stage.—*Mary Frances Vastine, M.D.*

Parchet, Victor. Un accident d'un genre nouveau dû à l'emploi des produits de contraste hydrosolubles en bronchographie. (A new kind of accident due to the use of water-soluble contrast media in bronchography.) *J. de radiol. et d'électrol. & Arch. d'électric. méd.*, 1952, *33*, 27–29.

For more than two years the author used systematically water-soluble ioduron B for bronchography. From the beginning, similar to other investigators, he was impressed by the rather frequent

appearance of a mild cyanosis associated with a certain degree of tachypnea towards the end of the examination. This cyanosis always disappeared rapidly following expectoration of the residue of the contrast medium and therefore never constituted a cause for alarm. Recently, however, he observed a case in which the reaction was much more severe.

The case, which is described in detail, was that of a fifty year old man who suffered from cystic bronchiectasis. After thorough anesthesia of the upper respiratory tree and of the lobar and segmental bronchial ramifications, 50 per cent ioduron B was injected into the right bronchial tree by carefully following the standard technique. It was noted, however, that the lower lobe could not satisfactorily be filled, although 30 cc. instead of the customary 20 cc. of the opaque medium was injected, and the examination was therefore discontinued. The patient immediately became very cyanotic, could not expectorate and his respiratory excursions practically ceased. Ten minutes after the completion of the injection an emergency bronchoscopy had to be done, and about 120 cc. of thick viscous gelatinous secretion was aspirated from the lower portion of the trachea, from the region of the bifurcation and from the right lung. This resulted in immediate disappearance of the grave asphyxial phenomena proving that the accident was due to the mechanical obstruction by the contrast material rather than to the anesthesia.

The author expresses the opinion that the water-soluble viscous ioduron B mixes readily with the bronchial secretions and when these latter are thick and abundant a jelly-like mass is formed, completely filling the injected lung as well as the region of the carina and of the lower trachea. The treatment, when promptly instituted, is simple. As a precaution, he advises administration of expectorants over a period of several days before bronchography, associated with preliminary bronchial aspiration, whenever excessive secretions are present.—*T. Leucutia, M.D.*

Korkis, F. Boyes. Mediastinitis following foreign-body perforation of the cervical oesophagus. *Lancet*, Jan. 5, 1952, *1*, 4–8.

The author reports 3 additional cases of suppurative mediastinitis secondary to foreign body perforation of the cervical esophagus with survival following surgical intervention, as well as the administration of chemotherapeutic and antibiotic agents. The author makes a plea for the theorem of early surgical intervention when clinical symptoms warrant since antibiotic and chemotherapeutic agents are available.—*Moris Horwits, M.D.*

Fleischner, Felix G. The esophagus and mediastinal lymphadenopathy in bronchial carcinoma. *Radiology*, Jan., 1952, *58*, 48–56.

Through observation of the barium-filled esophagus much information can be obtained about the posterior mediastinum down to the diaphragm. An esophagus normal in position, width, and contour, with unobstructed passage of the contrast medium, provides fairly good evidence of the absence of gross posterior mediastinal abnormalities. The authors discuss the normal and pathologic narrowings of the esophagus as usually described and call attention to the one area of the esophagus which is usually not mentioned in textbooks. This area is that portion of the esophagus immediately below the bifurcation of the trachea where the bifurcation lymph nodes are located. Enlarged paratracheal, tracheobronchial and hilar lymph nodes are usually quite prominent in posterior anterior and sagittal views of the chest. The enlarged bifurcation lymph nodes, however, are best brought into relief by demonstrating their compression of a barium-filled esophagus. Since these lymph nodes lie anteriorly and slightly to the right, the compression occurs usually at the right anterior aspect of the esophagus and therefore is best seen in the left anterior oblique view.

The indentation starts immediately beneath the left bronchus, extends downward for a distance of about 5 cm., and causes some narrowing of the esophageal lumen. The mucosal folds are usually undisturbed, but slight irregularities or rigidity may occasionally be seen at the indented part. This is unassociated with any dysphagia.

It is noted that enlargement of these bifurcation lymph nodes may be due either to inflammatory or neoplastic disease. The significance of detection of mediastinal lymphadenopathy in bronchial carcinoma is important in determining the therapeutic indications and prognosis.—*D. N. Dysart, M.D.*

Hirsch, A., and Kapferer, J. M. Ungewöhnliche Erweiterung der Trachea als Tuberkulosefolge. (Unusual dilatation of the trachea due to tuberculosis.) *Schweiz. Ztschr. f. Tuberk.*, 1952, *9*, 136–140.

This is a case report of a saccular circumscribed tracheal dilatation due to tuberculosis. Conventional roentgenograms of a patient with bilateral active tuberculosis showed a peculiar circumscribed radiolucent area in the right apex, which was considered to be a cavity. A laminagram, however, demonstrated a saccular well circumscribed dilatation of the trachea corresponding to the above area. Roentgenograms, taken after introduction of iodine containing contrast material, confirmed this unusual finding.

The authors believe that an ulcerating tuberculosis of the trachea some years ago had led to the tracheomalacia, which in turn, due to the fibrosis of the right upper lobe, caused the unusual picture of a localized saccular dilatation of the trachea.—*Hans W. Hefke, M.D.*

Tänzer, A., and Beutel, A. Zur tracheographischen Diagnostik der Luftröhrenkrebse. (Tracheographic diagnosis of cancer of the trachea.) *Radiol. clin.*, Jan., 1952, *21*, 1–10.

Although the incidence of cancer of the bronchus has increased alarmingly during the past twenty years, primary cancer of the trachea continues to remain a comparatively rare disease. Therefore, the authors feel justified in reporting 2 personal cases which may contribute toward the clarification of the roentgen symptomatology.

A review of the literature reveals that space occupying tumors of the trachea can be satisfactorily demonstrated by simple roentgenography, contrast tracheography and laminagraphy, used singly or, to greater advantage, in association with each other.

Fraenkel, who observed 10 cases of carcinoma of the trachea, classified the lesions into two types: (1) the circumscribed type, which has a broad base, is spherical or oval in shape, and projects into the lumen of the trachea; and (2) the diffuse infiltrating type, which extends with a smooth or slightly nodular surface over a greater area, invades the tracheal wall and soon penetrates into the adjacent peritracheal, periesophageal and mediastinal tissues. One of the important signs in both types is the tendency to ulceration, leading to repeated small hemorrhages with a blood-tinged sputum. Other characteristic signs are: the preferred localization in the upper third of the trachea and somewhat less frequently in the lower third, whereas the middle third is hardly ever involved; the extremely rare perforation into the esophagus or thyroid gland whereas carcinomas of the esophagus and thyroid often perforate into the trachea; and the early spread to the regional lymph nodes followed not infrequently by metastases to the lungs, liver, spleen, pancreas, kidneys and osseous skeleton.

In the authors' first case, which was that of a man forty-six years of age, the carcinoma was of type 1; it produced early metastases to the regional lymph nodes of the neck and upper mediastinum with atelectasis of the right upper lobe and paralysis of the right phrenic nerve; and in the terminal stage it spread to the skin of the right abdominal wall. This latter manifestation is, according to Keeney, a differentiating criterion from carcinoma of the larynx. The second patient, a man forty-eight years of age, had a carcinoma of type 2 which likewise rapidly extended to the cervical and mediastinal lymph nodes, resulting in atelectasis of the right upper lobe and paralysis of the right phrenic nerve, followed by massive right-sided pleural effusion.

The authors obtained good tracheograms in both cases and they reproduce them to illustrate the different appearance in the two types of lesions. The association of these roentgen findings with the clinical evidence of rapidly developing metastases established the diagnosis of primary carcinoma of the trachea beyond doubt.

That such a symptom-complex is characteristic of carcinoma of the trachea was postulated, on a theoretical basis, by Beutel and Strnad already in 1937. The present 2 cases are examples strongly supporting this postulate.—*T. Leucutia, M.D.*

Jahn, Richard, P., and Olinger, John K. Linear basal atelectasis following therapeutic phrenic nerve interruption. *Am. Rev. Tuberc.*, Jan., 1952, *65*, 88–92.

Three hundred and sixty-one therapeutic phrenic nerve interruptions were performed at Muirdale Sanatorium, Milwaukee, Wisconsin. In nearly 10 per cent (23 cases) characteristic linear basal shadows developed which have been called "plate-like" atelectasis since the work of Fleishner in 1936. With the resumption of diaphragmatic function these areas of atelectasis usually disappear.—*Edward Julien, M.D.*

Gershon-Cohen, Jacob, and Ingleby, Helen. The roentgenology and pathology of cyclic disturbances in the breast; with special reference to their surgical diagnosis. *Surg., Gynec. & Obst.*, Jan., 1952, *94*, 91–102.

In a series of 200 consecutive breast cases which came to operation roentgenologic and pathologic studies were made. The following classification of breast lesions was used:

1. Mazoplasia: Group 1, Group 11
2. Fibroadenoma
3. Secretory cystic disease (with or without plasma cell mastitis)
4. Papilloma
5. Schimmelbusch disease (mastopathy)
6. Carcinoma.

Mazoplasia (53 cases). In group 1 the roentgen findings are characterized by a uniformity and homogeneity of the tissue density in the breast. The anterior surface of the breast tissue proper is sharply separated from the layer of overlying subcutaneous fat. In group 11 the roentgen appearance of the breast is similar to that of group 1 but, because of the pressure of cysts, other patterns supervene. Small cysts may not be recognizable in compact, dense breast tissue but larger cysts, especially if fat is also present, become clearly delineated due to their sharp, smooth margins.

Fibroadenoma (37 cases). These originate in circumscribed foci of mazoplasia. They are less radiopaque than a cyst and large fibroadenomas will push the surrounding trabeculae aside in the same manner as a cyst. Small fibroadenomas are apt to merge with the surrounding parenchyma. Single fibroadenomas are not as symmetrical in outline as cysts. In older people the fibroadenoma may undergo calcification.

Secretory cystic disease (16 cases). The roentgenograms show coarse digitations, often flame-like in shape, which run in the line of the breast trabeculae. Should plasma cell mastitis supervene, a localized tumor appears surrounded by a zone of edema.

Papilloma (7 cases). Diagnosis in this condition is most easily made in patients in whom a discharge from the nipple contains particles of the growth. However, roentgen examination is often of assistance. The affected ducts are elongated and varicose. There may be some resemblance to secretory cystic disease but broad, finger-like trabeculations are usually not seen, and if present, are scanty.

Schimmelbusch disease (4 cases). The roentgenologic picture of this condition closely resembles and may be indistinguishable from that of advanced mazoplasia. Usually the changes are more marked than in mazoplasia group II and there is greater distortion of the entire architectural pattern. The breast is crisscrossed by many secondary trabeculae. —*Mary Frances Vastine, M.D.*

Somerville, Philip. Carcinoma of the male breast; a report of 19 cases and a review of the literature. *Brit. J. Surg.*, Jan., 1952, *39*, 296–303.

This article thoroughly reviews the literature and adds 19 new cases. The facts presented demonstrate that the incidence is a hundred times greater in the female; however, the age incidence is considerably higher in the male, averaging at the sixth decade of life. No new contribution on etiology or diagnosis is made. However, in agreement with most authors and in contradistinction to Geschickter, the author states that the prognosis is generally poorer in males than in females. This is due to several factors, among which are early metastasis because of little restraining soft tissue and physician-delay in diagnosis because of a low index of suspicion. The therapy in the 19 presented cases consisted of radical mastectomy and/or roentgen therapy.

The series is not large enough for statistical analysis; however, only 1 case is alive after five years and the histopathology is not given for this case.—*Frank R. Hendrickson, M.D.*

Shapiro, Robert. Thrombosis of the internal carotid artery. *Radiology*, Jan., 1952, *58*, 94–99.

The etiology and pathology of thrombosis of the internal carotid artery are discussed in detail. Symptomatology is variable depending upon the extent of occlusion, the rapidity with which it develops and the extent of collateral circulation. The first objective neurological manifestation is usually a contralateral spastic hemiparesis involving chiefly the arm. Subsequent manifestations including visual changes are described. Collateral circulation of the orbit is discussed at length.

Carotid arteriography presents classical vascular changes in thrombosis of the internal carotid artery. Attempts to visualize the artery on the involved side are unsuccessful. Usually there is excellent filling of the external carotid branches. If the occlusion occurs proximal to the origin of the ophthalmic artery, this vessel is usually enlarged and its anastomosis with the branches of the internal maxillary artery in the orbit can frequently be demonstrated.

Three case reports are presented.—*E. E. Seedorf, M.D.*

Foltz, Eldon L., Thomas, L. B., and Ward, A. A., Jr. The effects of intracarotid diodrast. *J. Neurosurg.*, Jan., 1952, *9*, 68–82.

Until recently, diodrast angiography was considered by many a procedure of relative safety. The occurrence of complications following cerebral angiography has not only been poorly documented in the past, but often unrecognized. In the face of recent increasing awareness of the clinical sequelae of this procedure, the authors detected an almost total lack of physiological investigation into the causes of these sequelae.

During intracarotid injections of diodrast into monkeys, cats, and humans, the authors observed directly and photographed in color the changes in caliber of pial vessels and recorded electroencephalograms, electrocardiograms, and cerebrospinal fluid pressures.

The experiments reveal that intracarotid diodrast has two primary effects on the brain: (1) a direct toxic action on the nerve cells; and (2) a protective vasospasm minimizing the amount of toxic substance reaching the nerve cells in any given period of time. The initial rapid vasoconstriction is followed by a longer lasting vasodilatation. Multiple electroencephalographic abnormalities seem to result from a direct toxic action of diodrast on the neurones. Routinely produced electrocardiographic or pulse rate abnormalities seem to be the result of central nervous system changes.

An interesting clinical application was suggested by the demonstration that warm solutions of diodrast produced less vasospasm but greater electroencephalographic changes than cool solutions, suggesting that a greater cytotoxic effect was produced. Unilateral stellate block also minimized the phase of vasoconstriction, and thus produced startlingly increased cerebral effects. Both stellate block and the warming of diodrast to body temperature prior to injection would therefore seem contraindicated. The use of these measures to achieve better roentgenographic contrast is done only at the expense of increased cellular damage.

The authors quote that complications representing major central nervous system damage follow diodrast angiography in about 14 per cent of clinical cases. This fact of the relative infrequency of major complications should not obscure the fact indicated

by this study that some diffuse damage including neuronal death may occur almost routinely as the result of diodrast angiography.

Numerous electroencephalograms accompany the paper.—*J. F. Walker, M.D.*

Ruggiero, Giovanni, and Castellano, Francesco. Carotid-cavernous aneurysm. *Acta radiol.*, Feb., 1952, *37*, 121–140.

Eleven cases of carotid-cavernous aneurysm have been studied. The onset of symptoms in the spontaneous cases is acute while in the traumatic cases it is often insidious. In the spontaneous cases the course is more severe and the prognosis is less satisfactory.

Arteriography is the only means whereby information as to the extent of the lesion, as well as to the anatomical relationships and the cerebral circulatory conditions, can be obtained.

Knowledge of the circulatory system of the brain —especially in the area supplied by the anterior cerebral artery—is of great importance in evaluating the efficiency of the collateral circulation after ligation of the carotid artery. Arteriograms obtained in axial projections are necessary. A bilateral examination should be carried out.

Regarding surgical treatment, the best results seem to be obtained by primary ligation of the common carotid artery. This can be followed by ligation of the internal carotid artery in the neck and/or intracranially. Contrary to the common opinion that the good results of this operation are due to a collateral circulation through the external carotid artery to the region vascularized by the internal carotid, the authors consider that they are caused by an increased blood flow through the contralateral carotid artery.—*Mary Frances Vastine, M.D.*

Schludermann, H. Über kongenitale und erworbene periphere Aneurysmen der Arteria pulmonalis. (Congenital and acquired aneurysms of the pulmonary artery.) *Fortschr. a. d. Geb. Röntgenstrahlen ver. m. Röntgenpraxis*, Jan., 1952, *76*, 8–24.

I. Congenital Aneurysms. Arteriovenous fistulae are developmental malformations, usually associated with other vascular anomalies. Fifty per cent of them are familial and observed in conjunction with Osler's disease (telangiectasis of skin and mucous membranes, bleeding tendency, heredity). Hemangiomas of all organs may be encountered without positive roentgenological findings. Arteriovenous fistula may be the only manifestation of Osler's disease, but Osler's disease is not necessarily accompanied with arteriovenous fistula.

The roentgenogram shows grapelike or wormshaped shadows in the lung parenchyma connected to the hilus by a wide tortuous band of increased density. Pulsations and a change in size with Valsalva's maneuver are not always demonstrable. Laminagraphy and angiography are very helpful, especially in demonstrating small fistulae.

One case is discussed in great detail and the symptomatology and pathology described.

Only the number of the blood corpuscles is increased in the pulmonary type and normal dynamics prevail in the lesser circulation. Both the plasma and number of blood corpuscles are increased in peripheral arteriovenous fistulae of the greater circulation, with normal hematocrit and circulatory failure.

Excision is the treatment of choice.

II. Acquired Aneurysms. Acquired peripheral pulmonary aneurysms are rare. They may be due to mycotic or rheumatic injury to the vessel wall, more rarely to thrombo-endarteritis and trauma. Aneurysms in the walls of tuberculous cavities are occasionally seen and cause hemoptysis.

The symptoms are usually overshadowed by the primary disease and the roentgen findings are accidental. The heart is enlarged in all cases. The roentgen diagnosis is difficult because of the surrounding changes in the lung parenchyma, but multiple, round, pulsating densities near the hilus are characteristic.

One case illustrating the difficulty in diagnosis is presented.—*Frederick M. Reis, M.D.*

Honig, Edward I., Steinberg, Israel, and Dotter, Charles T. Innominate artery: angiocardiographic study. *Radiology*, Jan., 1952, *58*, 80–88.

An angiocardiographic study of the normal and abnormal innominate artery is presented. Buckling of the innominate artery most commonly occurs with hypertension and arteriosclerosis. It does not give rise to any significant symptoms. Angiocardiography differentiates it from retrosternal thyroid, innominate or carotid artery aneurysm, mediastinal infection, or neoplasm, and therefore may eliminate exploratory surgery.

The recognition of syphilitic innominate artery aneurysm and the demarcation of its anatomical point of origin are important for the proper institution of therapy. Innominate artery aneurysm was present in 12 of 57 patients with syphilitic aneurysm.

With coarctation of the aorta, the innominate artery as well as the left subclavian artery may be markedly dilated and tortuous.—*E. E. Seedorf, M.D.*

Abdomen

Herrmann, K. O. Der röntgenologische Nachweis der aktiven Entleerungstätigkeit des Musculus Sphinkter Oddi. (Roentgen demonstration of the active emptying function of the muscle of sphincter of Oddi.) *Fortschr. a.*

d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis, Dec., 1951, *75*, 684–694.

On roentgen films exposed very rapidly, Bernhard could demonstrate wave-like movements in the region of the muscle of Oddi, which would speak for an active emptying function of this muscle. The author undertook to analyze the emptying process by roentgen study. Since it is harmful to the patients to subject them to roentgen examination for too long a period, an entire series of the emptying function of the muscle of Oddi could not be demonstrated on one patient. Accordingly, 3 patients were used for the study.

The function of the muscle was observed through a choledochotomy following oral administration of egg yolks and the visualization of the bile passages with thorotrast, introduced through a catheter. Thus, it was seen that, under the stimulation of egg yolks, there was an increase in peristalsis in the region of the duodenum, and the peristaltic rhythm continued so that three to five peristaltic movements could be seen within fifteen seconds, propelling the contents of the duodenal bulb to the ascending portion of the duodenum. The author has attempted, with the aid of a duodenal sound and sensitive balloons, to measure the pressure of the pendulum movements and the peristaltic waves and found that in humans a peristaltic wave produced a pressure from 200 to 300 mm. of water. The pendulum movements registered 40 to 50 mm. of water. During the time of increased peristaltic movements of the duodenum and after feeding with egg yolks, the contrast material from the large bile passage empties as frequently as three to eight times into the duodenum. The outpouring of the bile was preceded immediately by a peristaltic wave of the duodenum. During the phase of emptying of the large bile passage, the sphincter of Oddi took part in the movements of the duodenum, it being displaced cephalad or caudad. The duration of the rhythmic movements of the common duct was about fifty seconds, each contraction phase lasting four to six seconds.

During these emptying phases, one could see very rapid peristaltic movements of the muscle of the common duct, which always ran cephalad-caudad and which were present only in the region of the sphincter of Oddi. The movements could be seen only when contrast material approached the papilla of Vater.

At the end of each peristaltic evacuation of the common duct a small thread-like shadow was noted in the region of the sphincter of Oddi. After this phase of emptying was completed, a deep peristaltic wave ran from the duodenal bulb to the ascending duodenum, the contents of the duodenum being passed on into the jejunum. As soon as this deep peristaltic wave had reached the mid-point of the descending duodenum, the thread-like shadow in the region of the sphincter of Oddi disappeared suddenly. After disappearance of this thread-like shadow, there was a complete contraction of the sphincter of Oddi lasting eight or nine seconds.

The duration of emptying could be shortened from twenty-three to fourteen seconds with egg yolk feeding. After the contraction, the emptying phase was renewed since food again entered the duodenum through the pylorus.

If one can find no cause for the emptying of the large bile passages into the duodenum, since the former consist of collagenous fibrous tissue, then only in the muscle of the sphincter of Oddi can there be a motor emptying action. It is believed that this muscle has two different sheaths, a circular layer which closes off the bile passages into the duodenum, and a partially oblique and longitudinal layer which performs the active emptying. Another muscle, the pylorus, has also been described which can be seen roentgenologically in many cases. The muscle system is a functional unit, and it is separated from the muscular wall of the duodenum by connective tissue.

In summary, the muscle of the common duct, which originally was considered to have only sphincteric action, is shown to have an active emptying function of the large bile passages. This fact was established roentgenologically with the aid of nutritive and pressure measuring stimulation of the muscle. The peristaltic movements of the duodenum serve only as supporting action when the sphincter of Oddi remains open for several seconds.

The article is accompanied with numerous, clearly outlined roentgenograms showing fine details of the contraction phases of the common duct.—*Samuel Richman, M.D.*

Fassio, Étienne. Les coudures de la vésicule biliaire. (Gallbladder angulations.) *Presse méd.*, Dec. 25, 1951, *59*, 1779–1782.

Gallbladder angulations, considered by some as anomalies, may be found in patients with epigastric disturbances. The authors limited their study to angulations of the body and fundus. Bartel, in 1916, described the phrygian cap from autopsy studies, as a developmental anomaly. Later authors found an incidence of about 4 per cent in routine cholecystograms. Boyden distinguished a retroperitoneal type due to a slight twist behind the peritoneal cover of the embryologic gallbladder fossa and a peritoneal type due to an abnormality in the fossa itself. Boyden described three anteroposterior curves in the embryo, one of which, at the junction of body fundus, he feels is related to the phrygian cap. A septum is the essential anatomic feature of the congenital variety of angulation.

While a phrygian cap may be silent, it is more often associated with gallbladder symptoms which may appear as crises with bilious vomiting. When the anomaly is congenital, these symptoms have usually been present for a long time with biliary

dyspepsia. When acquired, the symptoms are intermittent. They are thought to be due to stasis and difficulty in evacuation. Crises due to partial occlusion are not relieved by decubitus. The roentgen findings are not pathognomonic. They only permit the diagnosis of cholecystopathy and dyskinesia and are particularly significant in the determination of reducibility.

Treatment is based upon what is thought to be the etiology.—*M. L. Sussman, M.D.*

Ulin, Alex W., Nosal, Joseph L., and Martin, William L. Cholecystitis in childhood; report of a case with common duct calculi. *J.A.M.A.*, Dec. 8, 1951, *147*, 1443–1444.

The authors state that true cholecystitis and cholelithiasis are rare in children and that common duct stones are even more unusual.

They report the case of a thirteen year old white girl who, when first seen by them, complained of pain in the right upper quadrant of twenty-four hours' duration. She had been well until elveen months previously, but since then had suffered from periodic attacks of right upper quadrant pain which ultimately radiated to the inferior angle of the right scapula. There had been two attacks of pain and jaundice in the preceding three months.

A cholecystogram revealed nonopaque calculi in the gallbladder. At operation the presence of these calculi was confirmed. The gallbaldder was not acutely inflamed, but its wall was slightly thickened. There was dilatation of the common duct and it contained two small mulberry or bilirubin pigment stones. The gallbladder was removed and the common duct drained for thirteen days. Follow-up visits for two years showed her to be in excellent health.—*A. E. Childe, M.D.*

Lasala, Atilio J. Secuelas postcolecistectomia. (Postcholecystectomy sequelae.) *Prensa méd. argent.*, Dec. 7, 1951, *38*, 3214–3224.

Sequelae following cholecystectomy are placed in three groups. The first group includes the less serious patients who complain of pain or dyspepsia, not requiring further surgery. The second group of patients present alterations similar to the initial clinical picture and generally require further surgery. The third group of patients present a clinical picture worse than that of the initial process.

In the first group there is first the dyspepsia caused by secretory insufficiency. When biliary function is relatively good, even in the presence of stones, and the gallbladder is removed, the sudden physiologic change results in diminution of gastric, pancreatic and intestinal secretions. This is not so prominent after removal of the nonfunctioning gallbladder, in which case the human organism has had time to adapt itself gradually. Pain occurring shortly after operation may be caused by a distended common duct with continent sphincter of Oddi. On the other hand, if the sphincter is incontinent, the constant flow of bile into the intestinal tract may result in diarrhea and sensation of burning in the anal canal. Hypochylia gastrica may be relieved by administration of hydrochloric acid and pepsin. Antispasmodics and pancreatic ferments may be added if indicated.

Hepatitis accompanying cholelithiasis may give rise to symptoms. Dyskinesias of various portions of the biliary tree, and especially of the sphincter of Oddi, may be present. If sphincteric spasm of severe degree is demonstrated at the time of operation, papillotomy or some form of biliary-duodenal anastomosis may be performed.

The second group under discussion consists of frank recurrence of the original syndrome. Among these are the patients who have stones in the biliary tree. These are often demonstrated at the original operation by cholangiography. Stricture of the terminal portion of the common duct or of the sphincter of Oddi is present in about 1 per cent. Sphincterotomy or biliary-intestinal anastomosis may be necessary. Prolonged hepatocholedocholic drainage may be of aid in these cases, as in patients who develop chronic pancreatitis. Residual lithiasis with or without neuroma of the cystic duct may require extirpation. Infection of the biliary tree may require medical treatment. A remnant of the gallbladder, if left at operation, may have to be removed. Extensive adhesions may form and cause symptoms. Biliary fistula may form in cholecystostomy patients in whom the surgeon elected to postpone actual removal of the gallbladder.

In the third group of most serious sequelae are included, first, biliary fistula and postoperative stenosis. Duodenal or colonic fistulae are also grave. Accidental ligature of the right hepatic artery (mistaken for cystic artery when anomalous) may result in hepatic necrosis. Biliary fistula produced by faulty relationship of the drainage tube in the common duct is also of serious import, necessitating removal of the tube, possibly dissection of partially obstructed ducts and choledochotomy.—*Charles M. Nice, M.D.*

Cave, Paul. Pyloro-duodenal spasm; its relaxation with procaine. *Brit. J. Radiol.*, Dec., 1951, *24*, 659–664.

In a series of 100 consecutive gastrointestinal examinations, 43 patients were encountered who exhibited some degree of spasm of the pyloric canal or duodenum. This spasm was either completely or effectively relaxed at the time of a subsequent examination immediately preceding which 50–100 cc. of a 1 per cent solution of procaine had been given orally.

When deformity of the bulb is present it usually indicates spasm, duodenitis, active ulcer or healed

ulcer with or without scarring, or a combination of these. Relaxation of the spasm with procaine permits more satisfactory examination of the duodenal bulb than is possible in the presence of spasm. Frequently the stream of barium through the bulb is less rapid, permitting a more leisurely and detailed examination. Fibrosis can be differentiated by this method from pure spasm without organic disease. Relaxation of spasm permits filling of some ulcer crater which would be otherwise obscured and craters remain filled for a longer period of time. The administration of procaine apparently does not influence the emptying time of the stomach.

The mechanism responsible for pylorospasm is not certain and by the same token the mode of action of procaine on the pylorus and duodenal bulb is not definite. It has been suggested that instead of acting as a local anesthetic it may actually be spasmolytic acting at the myoneural junctions.—*E. F. Lang, M.D.*

Barlow, T. E., Bentley, F. H., and Walder, D. N. Arteries, veins, and arteriovenous anastomoses in the human stomach. *Surg., Gynec. & Obst.*, Dec., 1951, *93*, 657–671.

The mucous membrane of the stomach has a rich blood supply consisting of arborizing leashes of capillaries which appear to fill almost completely the glandular layer (similar to a vascular sponge). The arrangement of vessels in the mucosa is the same in all parts of the stomach.

The capillaries of the mucosa are supplied by long mucosal arteries about 120 microns in diameter. These cross the submucosa obliquely to penetrate the muscularis mucosae and reach the glandular layer. In the anterior and posterior walls of the body of the stomach, these mucosal arteries arise from an extensive plexus of large vessels in the submucosa which in turn is supplied by branches from the arterial chains on the greater and lesser curves. In the pyloric antrum there is a similar arrangement except that the plexus in the submucosa consists of smaller vessels.

In the region of the lesser curvature the mucosal arteries do not arise from a plexus of vessels within the stomach wall, but have their origin outside the stomach directly from the right and left gastric arterial chain.

There is a wide connection of the mucosal arteries throughout the stomach by their free anastomosis as they approach the muscularis mucosae and again on the glandular aspect of that muscle. The freely anastomotic nature of the vessels of the stomach wall is perhaps its most notable feature. There are no anatomical end-arteries. The mucosa lies within a large vascular network consisting of anastomosing mucosal arteries and the submucous plexus of large vessels, in communication with the arterial chains on the greater and lesser curves. Whatever the physiological mechanism of control may be, channels exist capable of bringing large quantities of blood to the mucosa or of transferring blood from one point to another in the stomach wall.

The shift of blood in the stomach wall is further facilitated by a mechanism for short-circuiting the mucosal arteries directly into the veins. These direct arteriovenous channels, up to 140 microns in diameter, commonly arise from the mucosal arteries, and their presence suggests a rapid means of directing blood into or away from the mucous membrane by purely local action involving relatively few vessels. The general arrangement of the vascular pattern in the stomach is summarized in a diagram reproduced in the article.—*Mary Frances Vastine, M.D.*

Paschlau, G. Magengeschwür und russische Kriegsgefangenschaft. (Gastric ulcer in German prisoners of war in Russia.) *Deutsche med. Wchnschr.*, Dec. 21, 1951, *76*, 1622–1624.

The paper is an evaluation of the case histories of 2,000 German soldiers returned from Russian prisoner of war camps. There were 19 cases of gastric or duodenal ulcers in this group (0.95 per cent). This number corresponds to the normal average in Germany. Thirty-seven cases who had a previous ulcer history remained free of disease while in captivity.

There were 104 cases of chronic gastritis in this group (5.1 per cent); 75 per cent of these had either decreased acidity or anacidity. The author believes that the very low protein content of the prisoner's diet decreased the constitutional disposition for manifestations of ulcer disease. In contrast, he believes that the increase in the number of cases of gastritis is due to the coarseness and poor preparation of the food. The author also believes that his findings indicate that gastric or duodenal ulcers do not develop on the basis of previous gastritis. It should be mentioned that not all of the ulcer patients had roentgen examinations of the gastrointestinal tract and that none of the patients were gastroscoped.—*E. G. Wissing, M.D.*

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THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

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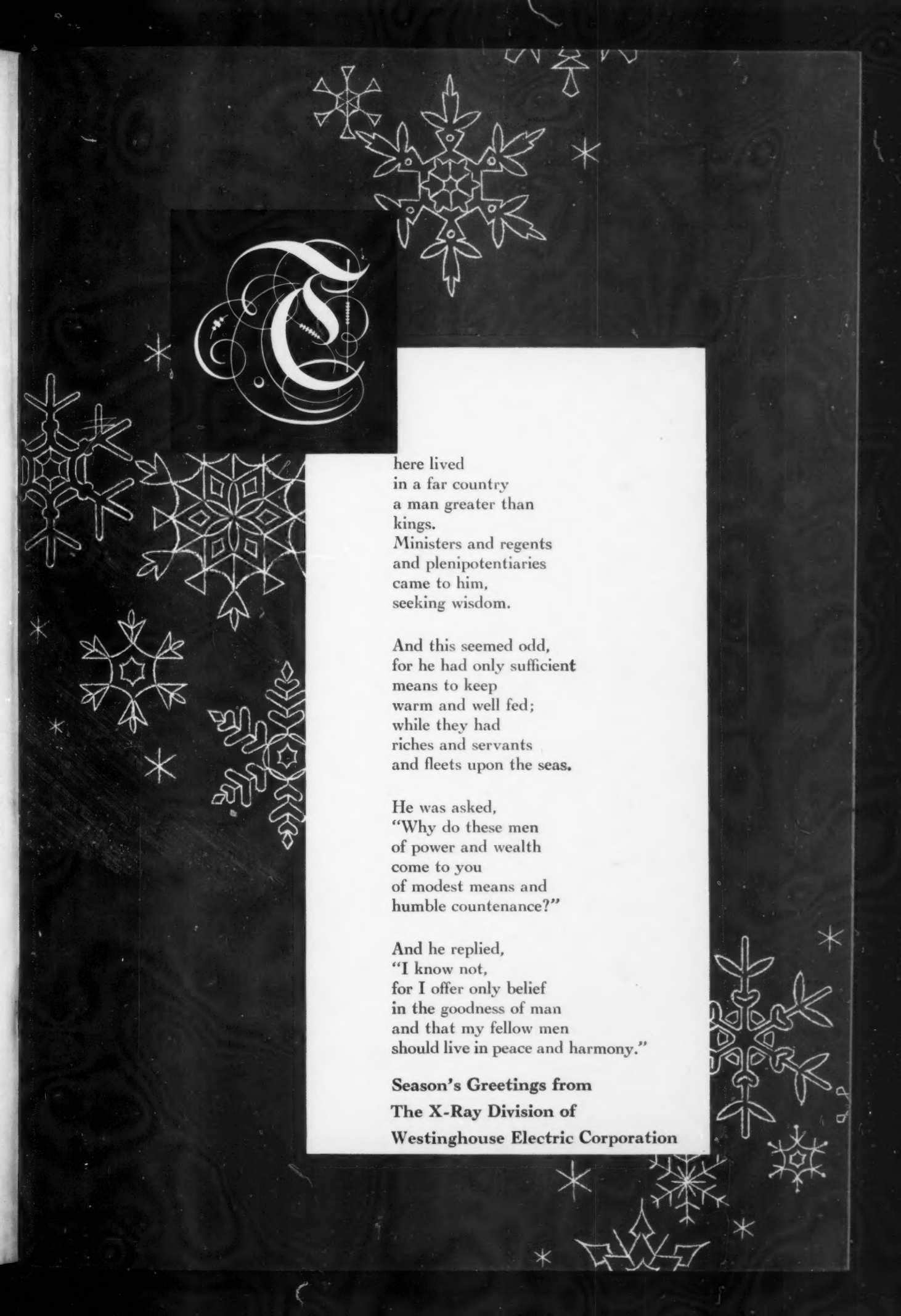

here lived
in a far country
a man greater than
kings.
Ministers and regents
and plenipotentiaries
came to him,
seeking wisdom.

And this seemed odd,
for he had only sufficient
means to keep
warm and well fed;
while they had
riches and servants
and fleets upon the seas.

He was asked,
"Why do these men
of power and wealth
come to you
of modest means and
humble countenance?"

And he replied,
"I know not,
for I offer only belief
in the goodness of man
and that my fellow men
should live in peace and harmony."

Season's Greetings from
The X-Ray Division of
Westinghouse Electric Corporation

a Christmas Greeting from Picker X-ray
bringing in the Yule Log in Chaucer's England